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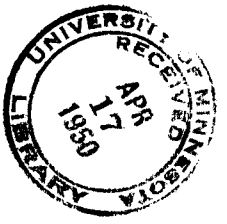

Legg-Perthes' Disease

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I. A RADIOGRAPHIC STUDY OF 191 CASES OF LEGG-PERTHES' DISEASE

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Introduction

The purpose of this paper is to analyze the radiographic appearance of 191 cases (212 hips) of Legg-Perthes' disease in an attempt: 1. to determine if certain signs seen in early films are of prognostic value; 2. to suggest a simple method of classification of end results; 3. to correlate type of treatment with end result, and; 4. to compare radiographic appearance with the clinical end result.

The term Legg-Perthes' disease will be used throughout this paper, instead of any of the other numerous synonyms, for the sake of clarity, because it is felt this term is the most widely used and understood in discussing this condition.

By Legg-Perthes' disease is meant that self-limited condition affecting the upper femoral epiphysis and metaphysis before closure of the epiphyseal line. It is characterized by radiographic appearances of irregular metaphyseal decalcification, epiphyseal fragmentation and a varying degree of final deformity of the head and neck.

This condition was first described in 1909 by Legg[24] of Boston and early in 1910 by von Perthes of Germany and Calve' of France. Prior to this time, certain cases diagnosed as tuberculosis were observed to heal much more readily and without the usual sequellae.

Osgood was the first to describe the radiographic appearance of a non-infectious, non-traumatic, rarefying lesion of the tibial tubercle in 1903 as the first in the series of osteochondroses. Since, hardly a bone except those of the head have not been reported involved in such a lesion.[34]

The Clinical Picture

The clinical picture is quite constant and typical. Limp, associated with pain (pain at first usually present only after strong exertion and disappearing after rest) in the hip or knee seems almost invariably present.[33,36,37] (Although Legg's original article on 5 cases pointed out the absence of pain as a characteristic.

A history of trauma is often obtained although of questionable significance. It occurs between the ages of 2 and 18 with 7-9 years being the most frequent range.[5] It occurs predominantly in boys[17] usually quoted as 4:1. Most large series reported have shown it to be bilateral in about 10%, although almost never synchronously.

Other findings frequently present include some limitation of motion, especially internal rotation and abduction. Flexion and/or adduction deformity is occasionally present. Clinical spasm seems in excess of the pain of which the patient complains.[12] A palpable thickening about the neck was reported by Legg and others.

One writer reported the presence of a positive Trendelenberg sign[32] although this is not substantiated by others or by the few cases checked in this series. The absence of constitutional symptoms is remarkable and was first noted by Legg. Those cases reported as having a fever, etc., at the onset could very well be a coincidence in an age group where upper respiratory infections are so frequent.

Shortening is sometimes clinically measurable, although this usually occurs late in the disease.

No laboratory test is consistently changed although some have reported changes in the calcium[10], sedimentation rate, white blood cell count, etc.

General Statistics

In the series of 191 cases (212 hips) here presented, the following statistics may be of interest at this point:

Age Range	. 2-18 years.
Average Age	. 8 15 (most fell into 5-10 range

Males	81.25%
Females	18.75%
Rt. & Lt. hips affected	equally
History of trauma	36%
Months before treatment	12.25 (aver.)
Bilateral cases	11.0%
Presenting with limp	Over 95%
Presenting with pain	Over 95%

Etiology

Exact information as to the cause of this condition is meager, yet speculation has raised many interesting possibilities.

Of these, trauma in some form enjoys the most popular following.[13,22,23,38] Although a fair number of case reports show onset following severe trauma as in traumatic dislocation[18] (possibly akin to some reductions of congenital dislocations), the trend of thought is toward a summation or an accumulative effect of many traumata each of which in itself would be insignificant. It is likened to the ischemic necrosis which may develop following prolonged use of a pneumatic hammer causing Kienboch's disease in the carpal lunate.

Hemorrhagic infarct from venous occlusion might well be the result of the etiological agent.[40] Severe trauma might cause a massive infarction[26] and multiple minute traumata forming a zone of petechiae causing necrosis proximally. (It has been shown experimentally in rabbits that interruption of the vessels of the ligamentum teres and periosteum of the neck, or sectioning the epiphyseal plate, leads to a similar condition.[29,41]

Regardless of which theory one finds most acceptable, it does not completely explain the problem. It may well be that a combination of factors are necessary and that this combination is not always the same. Thus, trauma in a patient with a familial tendency (and such tendencies have been reported repeatedly)[19] or hereditary factor[11] might be more likely to cause the condition than where such combination did not occur.

Sub-clinical hypothyroidism might be contributory[7], however, it should not be confused with a disease of the hip occurring in frank hypothyroidism which is somewhat similar radiographically, but is always bilateral and improves readily on thyroid therapy.[2]

The apparently identical pathology in Legg-Perthes', Kohler's, Kienboch's and other diseases in this category[16] lead some to the conclusion that Legg-Perthes' may be just part of a disturbance in the epiphyseal system.[1,28] However, this does not appear to be the case.

Certain cases which superficially look like Legg-Perthes' are found to behave differently, and radiographs of the skeleton will reveal other epiphyseal anomalies and lead to a diagnosis of one of the congenital epiphyseal dysplasias with correspondingly different prognosis.[8]

The theory based on infection[30] has been quite thoroughly disproved by the consistently negative cultures of many investigators.

The developmental theory of Murk Jansen and the acetabular" theory of Lipscomb and Chatterton[27] lack confirmation.

There may be some racial tendency judging from series of cases from sections of the country where hospital population is 15-20% colored and yet there is a conspicuous absence of negroes in their series.

Gross Pathology

Extremely few thorough reports of the gross and microscopic appearance of a hip joint involved with this condition have been published. It is, of course, easily understood that in a benign disease which heals spontaneously one would

be very hesitant to explore such a hip when the likelihood is that one would do more harm than good.

However, a few good reports are available, and certain observations are of interest.

Grossly, the synovium during the active stage is thickened, soft, fragile, very vascular and often irregular with villus formation. The ligamentum teres is found covered with this thickened synovium also.[31]

In the healing stage the synovium is found to be smooth, inelastic and tough. It is ivory in color and appears avascular.

The periosteum and capsule are usually thickened and edematous during the active phase but essentially normal in the healing phase.

The synovial fluid appears normal.

The appearance of the cartilage varies somewhat, apparently depending on the phase of the disease and the severity of the involvement. It has been variously described as smooth and normal in appearance, flattened, and, in severe cases, as flattened with folds in the surface and deep crypts between them. However, the head is never as flattened as expected from the radiographic appearance.[20]

The acetabulum is always normal in appearance except in certain late cases where adaptive changes have occurred to accommodate a deformed head.

The ligamentum teres was usually missing from the specimens available but one reported it as protruding stiffly, markedly injected and edematous, while another described it simply as flattened and lengthened.

Certain characteristics are notable on the cut section of the femoral head.

The cartilage appears normal except for varying in thickness (from $\frac{1}{2}$mm. to 5mm.). The cartilage is separated from apparently normal bone by a broad band of reddish tissue of putty-like consistency. The epiphyseal line usually appears intact. Bony tissue in some areas appears grossly normal. In areas of necrotic bone, fissures are seen which probably represent pathological fractures.

Microscopic Pathology

Microscopically, a little more information is available since drilling operations as well as biopsies provide material even when the whole specimen is not available.[35]

As one would expect from the gross description of the synovium, round ligament and capsule, they show edema and clusters of lymphocytes. The surrounding soft tissues are extensively scarred and contain thick-walled vessels with a small lumen. Occasionally, one is completely obliterated. Some extra-vascular red blood cells are seen as well as granulation tissue, but no thrombi have been noted.

Of primary interest is the microscopic appearance of the epiphysis. The cartilage, which grossly appeared relatively normal, is found to be variable in thickness, fibrillation of the matrix and cells that are clustered together or imperfectly aligned. Nearly all the calcified layer of cartilage as well as the sub-adjacent bone trabeculae have disappeared.

In the nucleus of the epiphysis, necrotic fragments of bone are found lying in a matrix of degenerated marrow and blood. Occasional areas of cystic degeneration are seen. Moderate numbers of mononuclear phagocytic cells are seen containing hemosiderin.

Still deeper in the nucleus, necrotic bone fragments are surrounded by loose granular tissue containing many blood vessels and osteoclasts. Many red blood cells but no inflammatory cells are seen.

The granulation tissue is continuous

with more or less dense fibrous tissue rich in capillaries but poor in cell elements, which seems to be originating from the outer edge of the epiphyseal cartilage[14] and to a lesser extent from the region of the ligamentum teres. In some areas this connective tissue is giving rise to osteoid tissue. The borderline between fibrous tissue and necrotic tissue is relatively sharp; with many multinucleated giant cells (phagocytes). New bone marrow develops from the fibrous tissue.

The epiphyseal line may appear to be damaged in small areas here and there, but on the whole is relatively intact.

No information is available on the changes seen in the femoral neck.

Treatment

One's first impression concerning treatment of Legg-Perthes' from a review of the literature might well be that a multitude of methods exist. However, closer analysis will reveal that they all fall into three general groups.

The first, restriction of all weight-bearing, usually meaning continuous bed rest with or without plaster, frame or traction. Practically all writers agree that this is good treatment, even though many feel it is more than is necessary. Plaster spica's, however, are not highly thought of, and there is evidence to show they aid demineralization of the hip region and, therefore, somewhat aggravate the condition.[4,6,9]

The second of these general groups of cases is that of treatment with some ambulatory form of restricted or reduced weight bearing. This usually means a brace or crutches, or a strap-sling and crutches (as used by L'Episcopo). This seems to be the most popular form of treatment, and for reasons to be set forth later, seems as adequate as necessary.

The remaining cases fall into the third group which consists of those that for one reason or another have no treatment at all or have so little as to be negligible. Evidence will be presented later to show that possibly no treatment or at most symptomatic measures may be sufficient for most cases.

In this series of 212 hips affected by Legg-Perthes' disease, only 6% were treated primarily by bed rest, while 72% were treated ambulatory (almost exclusively with a Thomas ring caliper brace). The remaining 22% had no treatment or had less than 6 consecutive months of treatment. This figure is, perhaps, somewhat arbitrary, but it is felt that a case with less treatment than this had little chance to be influenced by the same in a condition where the process takes three to four years to complete.

The results of treatment (or lack of it) will be presented subsequently.

Other possible adjuncts to treatment include the use of thyroid and the drilling operations of the femoral head and neck.

Aside from the rare instance of changes in the hip due to juvenile myxedema where thyroid therapy is definitely indicated, little evidence is available for or against its use. The number of cases in this series getting it was too small and the treatment usually of insufficient duration to allow any accurate conclusions.

From a review of the literature one gains the impression that surgical procedures seem to be of little value either in shortening the course of the disease or improving the end results.[25] These measures should be reserved for the late stages where a poor end result has occurred, and then arthroplasties, shelving or even fusion considered.

No surgical procedures were done in the active stage of this series except one cup arthroplasty.

Radiographic Characteristics

Only by the radiographic appearance

can the diagnosis of Legg-Perthes' disease be made with certainty. Consequently, it would be well to review the characteristic signs.

Usually a patient must have symptoms about two months before the earliest radiographic changes are observed. The first change usually consists of irregular decalcification of the femoral neck near the epiphyseal line. This decalcification may take one of several forms: 1. It may form a solitary cyst-like area which has lead some to feel this may be due to a thrombosis of a vessel causing this "infarct". 2. There may be several large, discrete, decalcified areas forming a band across the neck. 3. The decalcification may be more uniform and thereby form a narrow band across the neck; or, 4. A wide band may occasionally be observed. It has been found useful to classify this metaphyseal change in the foregoing manner as it seems to bear some relationship to prognosis as will be mentioned later.

It seems that the more decalcification present the greater the tendency to shortening of the neck. Therefore, treatment with plaster spicas which definitely causes decalcification would be contraindicated.

The epiphysis is next to show changes, beginning with compression. The trabecular pattern is lost and it becomes more dense in appearance. "Fragmentation" occurs some months later and tends to be more marked opposite the site of earliest change in the metaphysis. The degree of "fragmentation" varies from essentially none to such a severe degree that the epiphysis all but disappears. The severity of this change seems to be correlated with the end result as will be described later. The epiphysis is noted to widen and extend beyond the rim of the acetabulum as tho it had been "extruded". Actually, however, it is more likely that the neck is thickened by subperiosteal bone formation due to irritation of the quite vascular periosteum, and the head grows out to meet it.

This addition of bone to the neck is quite constant and begins early in the course of the disease. In fact, one writer suggested it as a useful sign to predict a hip which was going to develop the disease, before the early changes just mentioned appeared--H. Courtney Gages sign.[15] This sign is of little value actually. First, because it does not always appear before other findings are seen, and secondly, because most cases are well beyond the earliest stage before they are first seen.

Another interesting finding which appears early is Waldenstrom's sign. As the head becomes compressed (smaller), it moves upward and laterally and causes a widening of the space between the medial aspect of the lower part of the head and neck and the lower half of the acetabulum. This is what Murk Jansen calls the deformity of the acetabulum responsible for the development of Legg-Perthes' disease, but it is not present in hips which are at first normal and can be followed through the disease.

Another very constant change is the widening of the joint space between the superior margin of the epiphysis and the acetabulum directly cephalad. Of course, there can be no actual space between the two joint surfaces. The increase in apparent space would at first be thought simply due to compression of the nucleus of the epiphysis, but there is also some thickening of the capital articular cartilage. This is thought to be due to the normal growth of cartilage in the absence of coincident invasion of its deeper surface by bone, this having died.

An early radiographic sign which seems to have been overrated, is the often mentioned "cap" and "mushroom" types of deformity. The former is supposed to lead to a less favorable end result than the latter. In this series, it was found difficult to determine the type in many cases (the typical ones were obvious but many were of an "inbetween" variety), making analysis on this basis of little value.

Occasionally one sees an apparent de-

fect in the epiphysis. As will be discussed later, this is an indication of poor prognosis.

The last of the early changes to be mentioned concerns a disturbance of Shenton's line, which to my knowledge has not previously been reported. It was noted on studying the films of this series that the continuity of Shenton's line was disturbed, in some, by an upward displacement of the portion of the line formed by the inferior border of the femoral neck.

Other cases were observed to have a normal Shenton's line or even an apparent downward displacement of the femoral neck portion. Quite likely the upward displacement is due to a collapse not only of the nucleus of the epiphysis as seen in the radiograph but also of the cartilage itself. Carrying this reasoning a step further, one would therefore expect a poorer end result in these hips, and such has been found to be the case (as will be shown later). Conversely, those in which the line remains undisturbed or seems to be displaced downward should then lead to a better end result, and this too has been found to hold true. Since there seems to be only a limited relationship between the degree of compression and the intactness of Shenton's line, then one is forced to assume the integrity of the head has been kept intact by the cartilaginous "dome", and further that the downward displacement (although never as marked as the upward may sometimes be) is due to the aforementioned thickening of the articular cartilage (which adds to the strength of this cartilaginous dome and again offers reason for the better end results seen in this group).

One must beware of mistakenly calling a line "displaced upwards" when in reality it is due to adduction of the limb or of believing it to be "displaced downwards" because abduction of the limb has been overlooked. This, then demands a routine of placing the feet together in taking the radiographs.

Further, this sign is valid only in earlier cases before thickening and/or beaking of the neck occurs or the line will be found to be consistently displaced downwards regardless of early appearances.

The degenerative phase, which takes on an average of 18-24 months, usually ends quite abruptly and the regenerative phase begins. This change may often be noticed in comparing two radiographs taken only two months apart. Usually the decalcification in the metaphysis is first to go, the neck looking normal long before the epiphysis is healed. Gradually, by a process of recalcification, the head returns to normal. The areas first affected being the first to recalcify. This process usually takes a little longer than the degenerative phase, perhaps 2-3 years. Concomitantly, the neck is widening to a variable degree. This is due to two processes: 1. to the laying down of laminae of subperiosteal bone along the superior surface of the neck, and 2. to the downward protrusion of the inner part of the metaphysis--which becomes the "beak" if it progresses excessively. From this beak and running laterally across the neck toward the greater trochanter is seen a line, the so-called trans-cervical line. The position and intensity of this line varies as to the degree of deformity. It is felt by some that this may account, somewhat at least, for the limitation of internal rotation.

Very late changes occur as adaptive acetabular changes and still later as degenerative arthritis.

In order to more clearly analyze the end results of this series, it was thought best to attempt some relatively simple classification of cases on the basis of their radiographic appearance. Consequently, the following system was used:

Grade 1 -- a perfect or excellent result in which the head is perfectly symmetrical, smooth and no shortening of the neck. There usually is some thinning of the epiphysis. There may be only slight enlargement of the head.

Grade 2 -- a case showing a smooth, symmetrical head, moderate enlargement, some thickening of the neck, little or no shortening of the neck and no beaking.

Grade 3 -- more marked enlargement of the head and widening of the neck, some beaking but no irregularity of the articular surface, and some shortening of the neck present.

Grade 4 -- includes the poorest results. These show irregularity of the articular surface, marked beaking, marked shortening of the neck and acetabular changes.

Some cases tend to fall between these gradings but one can, by rigidly following the above descriptions, find each will fit one closer than the other. It will be shown later that these gradings have more significance than just a radiographic appearance.

Results

Numerous devices and measurements were employed in an attempt to determine what early radiographic signs were of prognostic value.

A large number of this series were subjected to measurement of the amount of light coming through the epiphysis and through the most decalcified part of the neck as compared to the normal hip. Two findings were noted: 1. the light meter could not detect changes in a femoral head sooner than the eye, and 2. there was no apparent correlation between the meter reading on the early film and the end result.

Again, the Eyre-Brook's index was calculated on the original, the mid-point film (that taken at the time when the regenerative phase is just starting) and the end result, on both the normal and the affected hip. This index is:

$$\frac{\text{Height of epiphysis}}{\text{Width of epiphysis}} \times 100 = \text{E.B. index.}$$

This index was originally intended as a means of classifying end results as compared to normal hips. His findings were as follows:

Normal in age under 7 = 45-55.
" " " over 7 = 35-45.

He then graded them into three classes, the first being the best radiologically:

Grade 1 = 28-48
Grade 2 = 20-34
Grade 3 = 14-29

The figures obtained in this series compare quite closely with the above. The normal for all ages from 3-18 was 40-60 with no significant difference for those above or below age 7. In comparing the above classification of three groups with the method used in this paper, it was found that those hips with an E.B. index of 20-40 fell in grades 1 and 2 while those with an index of 10-20 came into groups 3 and 4. This, then, is in general agreement, but there is such an overlap in the E.B. method of classification that an index of 20 could put a case into either the best or the worst group (and many of the cases were in this inbetween range.) The E.B. index does not take into consideration the irregularities of the articular surface, the shortening in the neck or the acetabular changes, all important to hip function, so this system of classification was considered inadequate and therefore not used.

The work done on the E.B. index did turn up one finding of interest although of limited value. It was observed in 34 cases that when the difference in height of the epiphysis (between the normal and affected hips) on the "mid-point" film is less than 5mm. the results tended to be good. This did not hold true at all for the same measurement on the early original films.

It was also found that there was no apparent relationship between the end result and the difference of lateral extension of the head beyond the acetabulum between the normal and affected hip unless this difference was over 12 mm.

These marked lateral extensions almost invariably denote a poor hip.

No apparent relationship exists between the difference of widths of the normal and affected epiphyses at the beginning or the mid-point with the end results.

It is well known that during the degenerative phase the amount of fragmentation of the epiphysis can be quite variable. Comparing the radiograph showing the maximum degree of "fragmentation" for a given case with the end result, some interesting data was accumulated. (One must be careful, however, to use only those cases with an adequate series of films to be sure the maximum degree is known.)

The arbitrary values used to grade degree of "fragmentation" in this paper were as follows: 1+ included those with no fragmentation and in which the epiphysis may be compressed but retained a homogeneous translucency sometimes referred to as ground-glass or melted ice appearance; 2+ showed some "fragmentation," usually at the poles of the epiphysis; 3+ meant the entire epiphysis was "fragmented" and usually quite thinned, whereas 4+ signified a complete "fragmentation" and almost a complete disappearance of the entire epiphysis.

Using the afore-mentioned classification to grade end results, the average grade for the respective degrees of fragmentation were as follows:

"Fragmentation"	Average Grade
1+	1.6
2+	2.4
3+	2.3
4+	3.2

It would seem, then that the more severely "fragmented" tend to give a poorer prognosis.

"Fragmentation" sometimes results in a peculiar "defect" in the central portion of the epiphysis. 34 cases in this series showed such defects of variable sizes. The end results were as follows:

No. of Cases	Grade Rating
3	1
5	2
8	3
18	4

Therefore, 76.5% of cases with a defect resulted in a grade 3 or 4 (mostly grade 4). If only those cases with a large defect are counted, the percentage with poor end results approaches 100.

It was observed that 82% of cases had a smaller obturator foramen on the affected side (the other 18% being equal or slightly larger) and 75% had a shorter length between the epiphyseal line that transects the acetabulum and the tip of the ischial tuberosity. This is similar to that found in unilateral congenital dislocation of hips and other conditions in which unilateral under-development occurs due to disuse. This is not a specific finding in Legg-Perthes' disease.

Many observers feel that the shortening which occurs in some cases of Legg-Perthes' is mainly due to collapse in the metaphyseal region and this, in turn, is somehow related to the degree of decalcification or "cavitation". Attention was, therefore, directed toward this region since it has been noted by several authors that the pattern of changes here differs.

The solitary cyst-like area was seen in only one case, so may be disregarded. The second type or band of discrete decalcified areas was found to be least frequently involved in cases with definite radiological shortening, the narrow band of decalcification more often, and a wide band of decalcification most frequently as shown in the accompanying figures:

Type of Decalcif.	% with Shortening
Discrete areas	14.66%
Narrow band	32.40%
Wide band	63.30%

The age of the patient has long been known to be in some way important to the outcome. The younger patients had the better end results, perhaps due to the fact that the nucleus becomes partly pulped so the integrity of the head depends mainly on the cartilage dome. The younger the patient, the thicker the cartilage and the smaller its span, consequently it is strongest at a time when deforming forces of body weight and muscle pull are not yet substantial.

It is impossible to determine whether it is the advancing age with its subsequent bone changes or if it is the increasing weight that has such an important effect on the end result, but the following figures show the effect of either or both very clearly.

Weight	Average Grade
Under 60 pounds (76 cases)	1.8
Over 60 pounds (37 cases)	3.6

Most patients are seen to be under 60 pounds because of the age at which this disease is most prevalent. Consequently this information is of little value in the individual case. However, when the case in question is over 60 pounds, the prognostic importance is realized. It was noted, (although there were only 7 such cases) that when the body weight was 90 pounds or more, the grade was 4 in every case.

The correlation of age to end result is presented in the following:

Age	Average Grade
2	2.0
3	2.0
4	1.3
5	1.8
6	2.0
7	1.9
8	2.7
9	2.4
10	2.6
11	3.0
12	3.2
13	3.5
14	4.0
15	4.0
16	4.0
17	4.0
18	4.0

Here again the value for prognostic purposes lies in realizing that over the age of 10 the chances for a good end result diminishes very rapidly. (In this series 30 cases were over the age of 10 and of these, only 6 were rated as grade one or two).

A brief examination of the small number of bilateral cases in this series may be of interest. 15 biltateral cases were followed to the healing stage and the end results graded. 7 cases had bilaterally poor results and two others had one poor hip.

9 cases -- same end result (grade) bilaterall.
6 cases -- first hip involved better than second.
0 cases -- was second hip involved better than first.

Therefore, in spite of the fact that the second hip was always seen and treated earlier (ave. 5 months before treatment started) than the first, in no instance was the second hip better than the first. In fact, in several cases the first hip was healed and required no treatment by the time the other one showed the process beginning. But in spite of the advantage of early treatment, the above results were recorded. Obviously, such a small number invites erroneous conclusions, but it does bring up the question of the value of treatment.

Results of Treatment

Many varities of treatment have been proposed and a number of them were used in the cases appearing in this series. However, if the cases are divided and re-divided into each specific form of treatment the groups become so small as

to have little statistical value.

There are three fundamental bases underlying the treatment (or lack of same) of all the cases in this series. They are: 1. No treatment, 2. some form of non-weight bearing treatment, and 3. cast, with or without weight-bearing.

In this series, 36 hips had no treatment and had an average end result of grade 2.5. 133 hips were treated with non-weight-bearing and were slightly better with an average grade of 2.1. The remaining 19 hips in this analysis were treated in plaster and had a significant average grade of 3.3.

One wonders from this if such prolonged and costly treatment is warranted in view of the small difference between the most popular type and no treatment at all. Certainly plaster spicas are contraindicated as most observers agree.

It is the opinion of many that treatment in the early cases is beneficial whereas the advanced case shows no anatomic improvement with any type of treatment. This statement is open to question after noting that the end result in this series had no apparent correlation with the duration of the disease before treatment was begun. The following table shows the results in cases from zero months before treatment (those few which came on in the second hip while the first was under observation) to 24 months.

# Months before Rx	Average Grade
0	1.3
1	1.7
2	2.0
3	1.9
4	1.5
5	2.7
6	2.3
7	1.9
8	2.1
9	2.0
10	2.6
11	1.8
12	1.9
14	2.5
16	3.6
18	2.4
24	2.6

Most felt that surgical treatment is not indicated except as a late reconstructive procedure for a badly deformed head.[39]

The use of thyroid is questionable. No case in this series had a prolonged course of it, but those receiving it for shorter periods of time (3-4 months) were not noticeably affected or changed from the predicted end result.

It should be remembered that the second hip to be involved in bilateral cases was never better than the first in spite of early diagnosis and more complete treatment.

It seems reasonable to conclude that treatment is definitely of value, but only insofar as it gives symptomatic relief and seems to have little or no effect on the end result. These end results are apparently pre-determined by other unknown factors.

Very little can be said about the shortening which occurs because of the paucity of accurate recordings. However, up to $\frac{1}{2}$" was noted in cases of all grades, but if the measurement was greater than this the case was almost invariably grade 3 or 4.

As was described above, a radiological sign involving a disturbance of the femoral neck portion of Shenton's line seemed to be of prognostic value. Correlation of this sign with the end results in 100 cases gave the following results:

73 cases showed the above mentioned part of Shenton's line to be normal or displaced distally. Of these, 46% were grade 1 and 39% grade 2; 13% grade 3 and 2% grade 4. Therefore, 85% were grades 1 and 2 or good end results and 15% were poor end results.

Of the 27 cases showing the opposite displacement, or upward, 26% were grade 3 and 52% grade 4 while 15% were grade 1 and 7% grade 2. Therefore, 78% were poor end results and 22% good end results.

It is felt that by this method 82% of cases were correctly graded from the earliest film, 18% were not.

Late Follow-Up

A paper of this type would be without value if the conclusions drawn didn't bear up under long time clinical observations. Consequently, follow-up examinations on 83 cases for from 5 to 20 years were recorded. 3 cases were contacted on their latest review by questionnaire, the rest were examined by various orthopedic surgeons. Of these 83 cases, 64 were 5-10 year follow-ups and 18 were 11-20 years. There was no tendency noted for cases to change their grade. That is, if one was graded "2" at the healed stage it was still the same grade 5-20 years later.

Of those patients whose hip was considered a grade one, 90% stated they considered the hip to be normal in every way. 10% mentioned occasional aching after much exertion. 20% of this group were found to have some loss of internal rotation, but this was not noticeable to the patient.

Of those patients with a grade 2 hip, 70% declared their hip was "normal". 21% noted occasional aching after much exertion. 9% had enough limitation of motion that the patient himself has noticed it, but it wasn't accompanied by pain. Another 28% had detectable loss of internal rotation which was unknown to the patient.

Of those graded "3", only 39% declared their hip was "normal". 44% had pain on exertion and the remaining 17% had noticeable limitation of motion but no pain was mentioned. Almost without exception examination of the hip disclosed limitation of motion (especially internal rotation).

In the grade 4 group, none declared their hip as "normal". 44% had pain on walking and in many this was disabling enough so the examining doctor advised a cup arthroplasty. The other 56% had definite (noticeable) limitation of motion and some had shortening of as much as $1\frac{1}{2}$".

In table form this data seems to show a close agreement with the predicted results.

Grade	30 Cases Grade 1	19 Cases Grade 2	18 Cases Grade 3	16 Cases Grade 4
"normal"	90%	70%	39%	0%
With pain	10%	21%	44%	44%
With clinical limitation of motion	20%	37%	99%	100%
With noticeable limitation of motion	0%	9%	17%	56%

Summary

It might be well, now, to summarize the points which are of importance in prognosis of a given case.

1. The relationship of the femoral neck portion of Shenton's line to the pubic ramus portion,

   a. if elevated, prognosis is poor.

b. if normal, or depressed, prognosis is good.

2. The degree of "fragmentation",

   a. the greater the degree of "fragmentation," the poorer the prognosis.

3. The type or degree of decalcification in the metaphysis.

   a. The wider the band of decalcification the poorer the prognosis.

   b. separated areas of decalcification ("cavitation") may be better than the diffuse type.

4. Age.

   a. The older the patient the poorer the prognosis (especially over the age of 10).

5. Weight.

   a. The heavier the patient the poorer the prognosis (especially over 60 pounds).

6. Defect in the center of the epiphysis.

   a. A large defect seemed to be almost a certain sign of a poor result while smaller defects were of less significance.

7. The difference between the height of the epiphyses in the mid-point film.

   a. Not of great value but if the difference is less than 5 mm., the prognosis tends to be good.

8. The second hip to be involved in bilateral cases tends, usually, to be the same as the first. It may be worse, but rarely better.

Conclusions

In conclusion, this paper makes no attempt at covering the subject of Legg-Perthes' disease completely. An attempt has been made, however, to summarize the more logical concepts of the disease as to its: 1. clinical manifestations, 2. pathology, 3. radiographic appearance is emphasized, 4. methods of classifying and predicting probable out-come, and 5. the results in this series of 212 hips.

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II. MEDICAL SCHOOL NEWS

Coming Events

April 17-19 Continuation Course in Gynecology for General Physicians
April 20 - Phi Delta Epsilon Lectureship - "Regional Ileitis", Dr. Burrill B. Crohn, Columbia University, Museum of Natural History Auditorium - 8:00 p.m.
April 20-22 Continuation Course in Cardiovascular Diseases for General Physicians
April 26 - Dr. A. C. Frazer, University of Birmingham, England, "The Mechanism of Fat Absorption," 15 Medical Science Amph. - 4:00 p.m.
April 26 - Annual George Chase Christian Lecture - "Cancer and Intermediary Metabolism of Steroid Hormones," Dr. Leo Samuels, University of Utah Medical School, 15 Medical Science Amph. - 8:00 p.m.
April 27 - Dr. A. C. Frazer - "The Normal and Abnormal Fat Absorption in Man," 15 Medical Science Amph. - 8:00 p.m.
May 9 - Duluth Clinic Lecture - "Metabolic Effects in Man of ACTH and Cortisone," Dr. Jerome W. Conn, University of Michigan Medical School - Museum of Natural History Auditorium - 8:00 p.m.
May 11-13 Continuation Course in Eye, Ear, Nose, and Throat for General Physicians

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Doctors Kirschbaum and Syverton Received Cancer Institute Grants

It has recently been announced that Dr. Arthur Kirschbaum, Associate Professor of Anatomy, and Dr. Jerome T. Syverton, Head of the Department of Bacteriology and Immunology, have been awarded grants by the National Cancer Institute. The grants, which are awarded for research in the field of cancer, will provide $6,750 for Dr. Kirschbaum and $14,711 for Dr. Syverton. Dr. I. M. Kolthoff, Professor and Head of Analytical Chemistry, also received a research grant from the National Cancer Institute.

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Continuation Course in Gynecology

A Continuation Course in Gynecology will be presented at the Center for Continuation Study April 17-19 under the direction of Dr. John L. McKelvey, Professor and Head of the Department of Obstetrics and Gynecology. The first day of the course will be devoted to urinary tract problems in the female. Throughout the remainder of the course, emphasis will be placed on diagnosis and management of uterine bleeding. Dr. Andrew A. Marchetti, Professor and Head of the Department of Obstetrics and Gynecology at Georgetown University, Washington, D.C., will be the visiting faculty member for the course. He will speak on the subjects, "Experiences with a Special Type of Repair for Urinary Incontinence" and "Benign Lesions of the Cervix." Clinical and full-time members of the University of Minnesota Medical School and the Mayo Foundation make up the remainder of the faculty for the course.

UNIVERSITY OF MINNESOTA MEDICAL SCHOOL
CALENDAR OF EVENTS

April 16 - 22, 1950

No. 285

Sunday, April 16

9:00 - 10:00 Surgery Grand Rounds; Station 22, U. H.

10:30 - 11:00 Surgical Conference; Rm. M-109, U. H.

Monday, April 17

9:00 - 9:50 Roentgenology-Medicine Conference; L. G. Rigler, C. J. Watson and Staff; Todd Amphitheater, U. H.

9:00 - 10:50 Obstetrics and Gynecology Conference; J. L. McKelvey and Staff; M-109, U. H.

10:00 - 12:00 Neurology Rounds; A. B. Baker and Staff; Station 50, U. H.

11:00 - Pediatric Rounds; Erling Platou; Sta. I, Minneapolis General Hospital.

11:00 - 11:50 Physical Medicine Seminar; E-101, U. H.

11:00 - 11:50 Roentgenology-Medicine Conference; Veterans Hospital.

11:00 - 12:00 Cancer Clinic; K. Stenstrom and A. Kremen; Eustis Amphitheater, U. H.

12:00 - 1:00 Physiology Seminar; 214 M. H.

12:15 - 1:20 Obstetrics and Gynecology Journal Club; Staff Dining Room, U. H.

12:30 - 1:20 Pathology Seminar; Primary Amyloidosis; Arthur Aufderheide; 104 I. A.

12:30 - 1:30 Surgery Problem Case Conference; A. A. Zierold, C. Dennis and Staff; Small Classroom, Minneapolis General Hospital.

1:30 - 2:30 Surgery Grand Rounds; A. A. Zierold, C. Dennis and Staff; Minneapolis General Hospital.

1:30 - 2:30 Pediatric-Neurological Rounds; R. Jensen, A. B. Baker and Staff; U.H.

4:00 - Medical-Surgical Conference; Bldg. I, Main Conference Room, Veterans Hospital.

4:00 - Public Health Seminar; Subject to be announced; 113 Medical Sciences.

4:00 - Pediatric Seminar; Magnesium Metabolism; Robert Aldrich; 6th Floor West, Child Psychiatry, U. H.

5:00 - 5:50 Clinical Medical Pathologic Conference; Todd Amphitheater, U. H.

5:00 - 6:00 Urology-Roentgenology Conference; C. D. Creevy, O. J. Raggenstoss and Staffs; M-109, U. H.

Tuesday, April 18

7:30 - 9:00 Fracture Rounds; General Hospital.

8:00 - 9:00 Fracture Conference; Auditorium, Ancker Hospital.

8:30 - 10:20 Surgery Conference; Small Conference Room, Bldg. I, Veterans Hospital.

9:00 - 9:50 Roentgenology Pediatric Conference; L. G. Rigler, I. McQuarrie and Staffs; Todd Amphitheater, U. H.

10:30 - 11:50 Surgical Pathological Conference; Lyle Hay and E. T. Bell; Veterans Hospital.

11:00 - Contagion Rounds; Forrest Adams; Sta. L, General Hospital.

12:30 - Pediatric-Surgery Rounds; Drs. Stoesser, Wyatt, Chisholm, McNelson and Dennis; Sta. I, Minneapolis General Hospital.

12:30 - 1:20 Pathology Conference; Autopsies; J. R. Dawson and Staff; 102 I. A.

1:30 - 2:30 Pediatric-Psychiatry Conference; R. A. Jensen and Staff; 6th Floor, West Wing, U. H.

1:00 - 2:30 X-ray Surgery Conference; Auditorium, Ancker Hospital.

2:00 - 2:50 Dermatology and Syphilology Conference; H. E. Michelson and Staff; Bldg. III, Veterans Hospital.

3:15 - 4:20 Gynecology Chart Conference; J. L. McKelvey and Staff; Station 54, U. H.

3:30 - 4:20 Clinical Pathological Conference; Staff; Veterans Hospital.

4:00 - 5:00 Physiology Surgery Conference; Eustis Amphitheater.

4:00 - 5:00 Pediatric Rounds on Wards; I. McQuarrie and Staff; U. H.

5:00 - 6:00 Porphyrin Seminar; C. J. Watson, Samuel Schwartz, et al; Powell Hall Amphitheater.

5:00 - 6:00 X-ray Conference; Presentation of Cases by Veterans Hospital Staff; Doctors Fkin, O'Loughlin, et al; Todd Amphitheater, U. H.

*8:00 p.m. Minnesota Pathological Society Meeting; Clinical Observations on Intersystem Diseases; C. A. McKinlay; Medical Science Amph., MeS.

Wednesday, April 19

8:00 - 8:50 Surgery Journal Club; O. H. Wangensteen and Staff; M-109, U. H.

8:00 - 9:00 Roentgenology-Surgical-Pathological Conference; L. B. Thomas and L. G. Rigler; Todd Amphitheater, U. H.

8:30 - 9:30 Clinico-Pathological Conference; Auditorium Ancker Hospital.

8:30 - 10:00 Orthopedic-Roentgenologic Conference; Edward T. Evans and Bernard O'Loughlin; Room 1AW, Veterans Hospital.

Wednesday, April 19 (Cont.)

8:30 - 12:00 Neurology Rehabilitation and Case Conference; A. B. Baker, Veterans Hospital.

11:00 - Pediatric Rounds; Erling Platou; Sta. I, General Hospital.

11:00 - 12:00 Pathology-Medicine-Surgery Conference; Surgery Case; O. H. Wangensteen, C. J. Watson and Staffs; Todd Amphitheater, U. H.

12:00 - 1:00 Radio-Isotope Seminar; Use of N_{15} in Study of Porphyrin Pigment Metabolism; Robert Aldrich; 113 Medical Sciences.

12:00 - 1:00 Surgery Problem Conference; General Hospital.

12:15 - Staff Meeting; Main Classroom, General Hospital.

3:00 - Pediatric Rounds; C. J. Huenekens; Sta. I, General Hospital

3:30 - 4:30 Journal Club; Surgery Office, Ancker Hospital.

4:00 - 5:00 Infectious Disease Rounds; Basement Amphitheater, General Hospital.

4:00 - 5:30 Cardiovascular Conference; Patent Ductus; M. J. Shapiro, J. W. LaBree, F. Adams, J. Jorgens, N. K. Jensen, T. C. Chisholm; E-101, U. H.

5:00 - 5:50 Urology-Pathological Conference; C. D. Creevy and Staff; E-101, U. H.

Thursday, April 20

8:30 - 10:20 Surgery Grand Rounds; Lyle Hay and Staff; Veterans Hospital.

9:00 - 9:50 Medicine Case Presentation; C. J. Watson and Staff; M-109, U. H.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

10:30 - 11:50 Surgery-Radiology Conference; Daniel Fink and Lyle Hay; Veterans Hospital.

11:00 - 12:00 Cancer Clinic; K. Stenstrom and A. Kremen; Todd Amphitheater, U. H.

11:30 - Pathology Conference Clinic; Main Classroom; General Hospital.

11:30 - 12:30 Clinical Pathology Conference; Steven Barron, C. Dennis, George Fahr, A.V. Stoesser and Staffs; Large Classroom, Minneapolis General Hosp.

1:00 - 1:50 Fracture Conference; A. A. Zierold and Staff; Minneapolis General Hospital.

4:15 - 5:00 Bacteriology Seminar; Some Aspects of the Bacteriology of Butter; Raphael Wagenaar; 214 M. H.

4:30 - 5:20 Ophthalmology Ward Rounds; Erling W. Hansen and Staff; E-534, U. H.

5:00 - 6:00 X-ray Seminar; Lymphoblastoma; Charles Nice; Todd Amphitheater, U. H.

Thursday, April 20 (Cont.)

7:30 - 9:30 Pediatrics Cardiology Conference and Journal Club; Review of Current Literature 1st hour and Review of Patients 2nd hour; 206 Temporary West Hospital.

*8:00 p.m. Annual Phi Delta Epsilon Lecture; Regional Heitis; Burrill B. Crohn, Mt. Sinai Hospital, New York City; Museum of Natural History Auditorium.

Friday, April 21

8:30 - 10:00 Neurology Grand Rounds; A. B. Baker and Staff; Station 50, U. H.

9:00 - 9:50 Medicine Grand Rounds; C. J. Watson and Staff; Todd Amphitheater, U. H.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

10:30 - 11:20 Medicine Grand Rounds; Veterans Hospital.

10:30 - 11:50 Otolaryngology Case Studies; L. R. Boies and Staff; Out-Patient Department, U. H.

11:00 - Pediatric Rounds; Erling Platou; Sta. I, General Hospital.

11:00 - 12:00 Surgery-Pediatric Conference; C. Dennis, O. S. Wyatt, A. V. Stoesser, and Staffs; Minneapolis General Hospital.

11:45 - 12:50 University of Minnesota Hospitals General Staff Meeting; Results of Therapy in Cervical Cancer; John L. McKelvey; Powell Hall Amphitheater.

12:00 - 1:00 Surgery Clinical Pathological Conference; A. A. Zierold, Clarence Dennis and Staff; Large Classroom, Minneapolis General Hospital.

1:00 - 1:50 Dermatology and Syphilology Conference; Presentation of Selected Cases of the Week; H. E. Michelson and Staff; W-312, U.H.

1:00 - 2:50 Neurosurgery-Roentgenology Conference; W. T. Peyton, Harold O. Peterson and Staff; Todd Amphitheater, U. H.

1:00 - 3:00 Pathology-Surgery Conference; Auditorium, Ancker Hospital.

3:00 - 4:00 Neuropathology Conference; F. Tichy; Todd Amphitheater, U. H.

3:00 - 6:00 Demonstrations in Cardiovascular Physiology; M. B. Visscher et al; 301 M. H.

4:00 - 5:00 Clinical Pathological Conference; A. B. Baker; Todd Amphitheater, U.H.

4:15 - 5:15 Electrocardiographic Conference; 106 Temp. Bldg., Hospital Court, U.H.

5:00 - 6:00 Otolaryngology Seminar; Review of Current Literature; B. Bofenkamp; Todd Memorial Room, U. H.

Saturday, April 22

7:45 - 8:50 Orthopedics Conference; Wallace H. Cole and Staff; M-109, U. H.

8:30 - 9:30 Surgery Conference; Auditorium, Ancker Hospital.

9:00 - 9:50 Medicine Case Presentation; C. J. Watson and Staff; E-221, U. H.

9:00 - 10:30 Pediatric Grand Rounds; I. McQuarrie and Staff; Eustis Amphitheater, U. H.

9:00 - 11:30 Neurology Conference; Neurology of Medical Diseases; Powell Hall Amphitheater.

9:15 - 10:00 Surgery-Roentgenology Conference; F. Ruzicka, O. H. Wangensteen and Staff; Todd Amphitheater, U. H.

10:00 - 11:30 Surgery Conference; O. H. Wangensteen and Staff; Todd Amphitheater, U. H.

10:00 - 11:50 Medicine Ward Rounds; C. J. Watson and Staff; E-221, U. H.

10:00 - 12:50 Obstetrics and Gynecology Grand Rounds; J. L. McKelvey and Staff; Station 44, U. H.

11:00 - Contagion Rounds; Forrest Adams; Sta. L, General Hospital.

11:00 - 12:00 Anatomy Seminar; The Proportion of the Different Types of Cells in the Anterior Lobe of the Hypophysis during Childhood, A. T. Rasmussen; The Early Anatomical History of the Lung, Dennis J. Kane; 226 I. A.

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* Indicates special meeting. All other meetings occur regularly each week at the same time on the same day. Meeting place may vary from week to week for some conferences.