

MECHANICS AND PATHOLOGY OF TUBERCULOUS HIP-DISEASE IN THEIR RELATION TO ITS DIAGNOSIS AND TREATMENT

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Some years ago, when I began a study of the cases of hip-disease which were then, and had been treated at the Hospital for Ruptured and Crippled, I began, at the same time, to study the literature on this subject. I soon discovered that there existed a great diversity of opinion regarding the treatment of this condition.

It was admitted on all sides that we were dealing with a disease for which we had no specific remedy, and that our only resource was to treat the condition from a purely mechanical point of view. As usually stated, the idea was to maintain the affected limb at rest in order to allay the inflammatory reaction; it was to be held in a manner which would permit of locomotion, so that the patient might obtain the benefit of fresh air and exercise; and finally the brace or apparatus to be used for this purpose should be so constructed that the limb would be in the best possible position for locomotion when the disease was cured or arrested.

In a word, the treatment for tuberculous hip-disease was, and, for that matter, still remains, a question of mechanics.

Now mechanics, as is well known, is a mathematical science. Such being the case, there should not be a diversity of opinion as to the mechanical requirements or the methods of fulfilling them. Given similar conditions, the indications must be similar. Hence, with a diversity of opinion as to the methods, it must be assumed that some or all of the methods in use for the treatment of hip-disease are inadequate.

It was in order to discover, if possible, the exact mechanical requirements to be fulfilled in the treatment of hip-disease, that I then began the study of the anatomic mechanics of the normal, as well as the tuberculous hip-joint, in connection with my clinical studies. The results of these studies cannot be presented in their entirety at present. I feel, however, that the importance of the subject justifies the presentation of some of the conclusions, though there can be only a brief allusion to the details of the work on which they are founded.

I shall call attention only to the few anatomic and mechanical details which bear directly on the questions to be discussed.

Of all the organic joints, the bones of the human hip-joint most closely resemble ideal geometrical figures. The head of the femur is part of an almost perfect sphere; it is, during life, closely embraced by the acetabulum and the cotyloid ligament; and these together form an almost perfect ball and socket joint. Hence this joint is in every way comparable to the inorganic ball and socket joint of the technician, and as such, is subject to the same mechanical laws and advantages.

Unfortunately, with the advantages which this perfect mechanical form brings, there exists the disadvantage, that slight incongruities of the articulating surfaces lead to marked impairment of function. It is for this reason that conditions which in other joints, would cause only a slight impairment of function, that

in time might be compensated for, lead to marked and often permanent damage in the hip-joint.

The extent of motion in the hip is considerably augmented by the length and slenderness of the neck. Here again the mechanical advantages of the structure are in a measure offset by the disadvantages which arise from this form; namely, great liability to distortion and consequent impairment of function under pathologic conditions.

In by far the majority of cases of tuberculous hip-disease, the lesion lies in the articulating bones. Roentgenoscopy in a large number of cases has borne out the pathologic investigations of the older writers in this respect. My own investigations have led me to believe that not only are the bones practically always affected, but that, in the majority of cases, the bone lesion is the primary one.

In a small percentage of cases the lesions may be in the neck outside of the capsule or in the trochanter, and, remaining so, the joint does not become involved. When this is the case the patient of course recovers with perfect joint function.

In by far the greater number of cases, the bones within the articulation are affected. In my own cases, the neck, the head, and the acetabulum were primarily affected in about the same proportions.

No matter where the disease begins it rarely remains focal. Not only does the actual focus extend, but surrounding it for some distance is an area of inflammatory atrophy, which, in the milder cases, may be moderate and more or less limited in extent. In the average case the inflammatory atrophy is marked and extensive; and in the severe ones, it leads to extensive bone absorption; separation or absorption of the head; complete absorption of both the head and neck, deepening or enlargement of the acetabulum alone, or in combination with the previously mentioned changes in the femur.

These changes depend on the character of the pathologic condition. I have seen them occur in cases treated by all known procedures. Braces, bed extensions, plaster spicas long and short, are powerless to prevent them.

Any one who will follow a large series of cases, treated according to any method will find this to be true. I have roentgenograms of a number of cases treated by means of the long-extension hip-brace (which is supposed to prevent absorption and destruction) which illustrates the usual course of events.

Hence, it is evident that not only have we no specific remedy, but we have not even the means to prevent or check the mechanical damage induced by the pathologic process.

This being true, what is the ultimate outcome of the condition? As we have no apparatus which will prevent atrophy and absorption, can we by the use of an apparatus retain the parts in their normal relations until some reparative process will restore, in a measure, the normal density, contour and relation of the affected parts? My experience leads me to believe, that restorative processes in hip-disease are practically absent.

If one follows the course of a number of cases of hip-disease, making frequent careful clinical and roentgenographic examinations it will be found that the course and final outcome will only vary within certain limits.

All the cases seen during the early stages will present nothing more than the symptoms of hip irritation;

that is, the same reaction which any inflammatory or irritative condition in or near the joint will induce. The hip-joint, depending on the degree of the irritation, will be held more or less firmly in a position of flexion, abduction and slight external rotation. It is held in this position not because there is a specific irritation of the muscles which maintain this position, but because this position produces the most complete relaxation of the hip under the existing mechanical conditions. Because of the course of the muscles which surround the hip-joint and the peculiar construction of the capsule and its accessory ligaments, this position must be assumed in order to produce relaxation. Whether the position assumed is voluntary or involuntary is beside the question.

At this stage it is impossible to make a positive diagnosis of tuberculous hip-disease, for the same symptoms will be present in all forms of inflammation in the joint or its neighborhood. In my own cases, I consider that I am not dealing with tuberculous disease when patients presenting these symptoms get well with perfect function, unless I can demonstrate an extra-articular focus by means of the roentgenogram.

Even when, as the subsequent course of the disease demonstrates, we are dealing with tuberculosis, roentgenoscopy shows definite changes in only a small percentage of cases at this time. I have rarely been able to demonstrate an actual focus during the early stages.

After a variable length of time, a symptom-complex occurs, which the older writers describe as the second stage of the disease. It has been the practice of late years to ridicule this division of the disease into two stages; yet, though the transition is gradual and the two stages of the disease cannot always be definitely separated clinically, what has been called the second stage of hip-disease undoubtedly corresponds more or less closely to certain definite pathologic and mechanical conditions.

It is at this stage that the bone atrophy and bone absorption with the consequent deformation begin. The course from now onward can be traced by roentgenoscopy. We are by this means enabled to say definitely whether or not we have femoral or acetabular disease or both.

Clinically, both these conditions manifest themselves in the same way so far as the deformity is concerned. That is, in both these conditions the result is adduction deformity.¹

The adduction like the abduction deformity is due, not to the specific nature of the disease, but to mechanical conditions. As has been said, the abduction is assumed to relax the hip-joint. That this position cannot be retained by muscular action alone, irrespective of other conditions, must be self-evident to every one with a knowledge of muscle physiology and mechanics.

1. The location of the disease, when it is not so acute that the patient resists all attempts to move the joint, can in a measure be ascertained by physical signs. From the examination of many cases, comparing the joint symptoms with the roentgenogram and what the mechanics of the condition would lead one to expect, I have learned to locate the site of the disease even without roentgenoscopy. For example, a high trochanter with limitation in abduction, the other movements being free, is indicative of acetabular disease. When all motions are limited except flexion and extension (rare in tuberculous hip-disease but not so uncommon in senile osteo-arthritis of the hip), there is central acetabulum disease leading to intrapelvic displacement of the head of the femur; when the neck alone is involved the objective signs closely resemble those of coxa vara, though in tuberculous hip-disease there is more general limitation of motion. A high trochanter with limitation of motion in all directions is indicative of marked deformation of the head of the femur. It must be remembered, however, that these differential signs can only be made out after the acute irritative symptoms (because the joint has been immobilized or the disease is arrested) have subsided.

Whether the muscular contraction which holds the hip in the abducted position is caused by so-called muscular spasm or is voluntary, the power of the muscles engaged in producing this position is entirely inadequate to retain it for any great length of time. The force of gravity soon overcomes it, and when there is no deformation (for instance, in synovial conditions which, by the way, are much more uncommon in the hip than in the knee) the limb will fall and will finally become adducted, unless prevented from doing so by some external force.

When there is no deformation of the bones the cause of the adduction deformity lies in the efforts of the patient to save the leg from weight-bearing. Unable to retain the abducted position to relax the hip, the patient tilts the pelvis on the other hip so that the foot of the affected limb barely touches the ground. This position becomes permanent, that is, we have what is known as adductor contracture; not because the adductor muscles contract actively, but because the distance between the origin and insertion of the adductors is lessened, and according to physiologic laws these muscles accommodate themselves to this distance. When there is deformation of either the femoral or acetabular part of the articulation, the normal angle between the neck and shaft of the femur or the normal angle between the mechanical long axis of the limb and that of the shaft of the femur is so changed that mechanically the limb must become adducted.

The position of adduction will occur either during or after treatment in practically all cases of hip-disease, unless the limb becomes firmly ankylosed in the abducted position. If the patient has been on a brace, the brace sometimes, certainly not always, will hold the limb in a straight line for the time being. As soon as the patient begins to walk, however, he acquires an adduction deformity. Cutting the adductors, stretching and even osteotomy of the femur will not prevent its recurrence.

It is needless to discuss the disadvantages of this position. Yet disabling as this deformity is known to be, it does not approach the disability caused by acetabular disease. In this case the femoral head is gradually pushed upward as soon as there is weight-bearing, until it becomes subluxated or completely dislocated. Such patients not only have an adduction deformity but must bear the weight of the limb on the more or less completely destroyed capsule and the gluteal muscles. The result is that these patients not only walk badly, but are exceedingly subject to hip-strain.

In all cases of recovery from hip-disease with distortion and motion, the final functional result, that is, the result in adult life (which is the only result to be considered), is poor in every respect.

Thus from a careful consideration of the anatomy, the physiology and the mechanics, I have been led to exactly the same conclusion as that arrived at by Lorenz empirically. That is, to judge from the pathologic and mechanical conditions, I believe that the only result which can give the patient a really useful limb in adult life is one with bony ankylosis.

Whether or not we can attain this result by means of the short spica is another question. There can be no doubt that the ultimate mechanical requirements are much more likely to be fulfilled when the limb is held in the most advantageous position with regard to weight-bearing, than with any of the methods of

treatment at our disposal at present. The tuberculous process in the bones is attended by a minimum of inflammatory reaction. It is only by weight-bearing or motion that we can stimulate the reaction processes to bone formation and thus increase the prospects for bony ankylosis.

Even when the treatment with the spica and weight-bearing is conscientiously carried out, unfortunately we do not always succeed in securing an ankylosis. I firmly believe that we should seek to produce ankylosis in all cases in which there is deformation or much atrophy, by operative measures as soon as the disease has become quiescent.

As all who have attempted to operate on these patients know, the conditions for operation are unfavorable in adult life. The exposure is difficult, the tissues are resistant and the adult does not withstand the operative measures nearly so well as do children. In children, on the contrary, the exposure is easy, the tissues are elastic and the operative risk is practically nil. Moreover, I think it a mistake to attempt to save atrophied bone. Healthy bone-surfaces should be brought into apposition, and weight-bearing, with the proper precautions, should be encouraged as soon as possible after the operation. It is of course ridiculous to expect stumps of atrophied bone to bear the weight of the body; they should be removed and if necessary the trochanter should be brought into contact with the denuded acetabulum.

Concerning the plaster spica treatment, the hip should be retained as nearly as possible in the middle position, that is, slightly flexed, abducted and only slightly rotated out. Eversion is a disabling deformity and should be scrupulously avoided. The spica, except when it is applied for the relief of irritative symptoms, need not, nor will it when it extends only to the knee, completely immobilize the hip.

It is, of course, impossible to give details; when a patient should be in bed, and when he should be up, will depend on the circumstances. Above all it should be remembered that there can be no invariable rules; for in every case the mechanical and pathologic conditions must be met as they appear in that particular instance. So, for instance, in the isolated acetabular cases, with enlargement of the acetabulum, it is often difficult to attain bony ankylosis, and sometimes impossible to prevent subluxation or dislocation even when the spica is worn constantly. In such a case I have used a Thomas knee-brace, so modified that there is a sole plate instead of extension rods and a snap joint at the knee, when the condition has become quiescent. In a number of cases so treated, I have been successful in preventing luxation for some years, even after the brace was removed. As none of these individuals have as yet attained their full height and weight, however, I do not know whether or not the result is permanent.

The conclusions here presented are based on a study of about two hundred cases. Particular attention was given to final results. By final results I do not mean that the condition at the time the patient was discharged with the disease supposedly arrested or cured, but the condition after such an individual had used his affected hip during adult life. I place absolutely no reliance on statistics, particularly those obtained by letter from patients or their family physicians who live at a distance.

The results of the study here presented in a somewhat general way may be summarized as follows:

Tuberculosis of the hip is a destructive disease, which practically always leads to marked impairment of the joint structures. So far as we know, there is no treatment which will prevent or limit the destructive process and we have not, therefore, a method which will prevent permanent impairment of joint function.

Such being the case, it must be admitted that we have no adequate treatment for hip-disease. For the present, we must be content to choose the method which will give the patient the strongest limb to stand and walk on, irrespective of joint motion or shortening.

At present the treatment with the short plaster-of-Paris spica, with all its shortcomings, is better than any other heretofore in use, provided it is scientifically carried out.

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BENZOL IN LEUKEMIA

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Last year I described two cases of leukemia treated with benzol (benzene, C_6H_6) after the plan of Korianyi. This article¹ is so recent that it will not be reviewed here. The extensive bibliography on the subject is also omitted; it was reviewed then, and Sappington and Pearson² have given a list of the articles on the subject to the date of their own.

Suffice it to say now that the patient with lymphatic leukemia referred to has since died. As suggested, benzol was discontinued shortly after the paper was printed because it seemed to have no effect on the leukemic process. So far as we could see, benzol neither helped nor harmed the patient.

The second case, one of the splenomyelogenous type, has been under observation almost continuously since Aug. 23, 1913, nineteen months. The length of treatment exceeds any that I have seen recorded, itself a matter of interest. The case is interesting, furthermore, because of the confirmation of some of my impressions expressed a year ago: until now certain fixed opinions relative to the worth of the drug and its dangers have been arrived at.

The mass of data accumulating in so many months may be omitted; that part of them which seems to have a bearing is given in the accompanying table.

The several features of this table stand out almost without the need of comment. What I shall have to say is more in the way of the conclusions to which they seem to lead.

A year ago I expressed the opinion that "benzol is a remedy of remarkable potency in myeloid leukemia." In spite of all that follows which may seem to argue to the contrary, I am convinced that it is the most helpful of all known agents in the treatment of leukemia of this type. When it is recalled that the patient under consideration was a boy of 13 years when the treatment was started; that his spleen then occupied about four fifths of the abdominal cavity, and that the leukocytes numbered 499,000, one is justified in expressing surprise that he is still living.

1. Smith, F. H.: Benzol Treatment in Two Cases of Leukemia, *THE JOURNAL A. M. A.*, March 21, 1914, p. 921.
2. Sappington, S. W., and Pearson, W. A.: The Leukemias under Benzol, *THE JOURNAL A. M. A.*, July 11, 1914, p. 143.