
The diagnosis of meniscus injuries; some new clinical methods.

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THE DIAGNOSIS OF MENISCUS INJURIES

SOME NEW CLINICAL METHODS *

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INTRODUCTION

In the year 1803, William Hey of Leeds wrote of a condition which he termed "internal derangement of the knee". This was not a clear-cut entity, but it did include the first, somewhat vague, description of locking; and Hey suggested that locking might be due to a meniscus lesion. However, as he treated his patients by manipulation alone, direct confirmation was not obtainable. The literature records hardly any progress in diagnosis for almost one hundred years, but the succeeding twenty or so years contain a galaxy of great names.

First Sir Robert Jones and later D'Arcy Power, Martin, and Morison recorded the results of numerous meniscectomies, and focused attention on the longitudinal split as the primary lesion. Then, in 1924, Bristow1 opened a discussion on internal derangement of the knee at a meeting of The British Orthopaedic Association; and since that time Bristow2, Platt3, McMurray, and others have described large series of cases of knee injury, with careful analyses of their findings. Despite the meticulous work in all these series, one feature stands out,—namely, the high proportion of cases in which no meniscus split was seen at operation. Sir Robert Jones quotes a figure of 10 per cent., while Bristow found that in 30 per cent. of his cases there was no split, this proportion including many normal and hypermobile menisci.

Many attempts at an explanation have been made, but as recently as 1930 Platt was driven to conclude that this group remained an enigma. However, by this time the rotation sprain of the knee, in which the attachments of the medial meniscus to the tibia, capsule, or tibial collateral ligament were damaged, had also been described; and various authors had already emphasized the difficulty in distinguishing a rotation sprain from a split meniscus.

With all these advances, two notable gaps remain: first, the absence of any constant and reliable pathognomonic sign for a split meniscus; and, second, the difficulty of differentiating a split meniscus from a rotation sprain. The purpose of this paper is to describe some methods which aim at filling these gaps.

THE CAUSAL FORCE IN MENISCUS DAMAGE

The causal force in meniscus damage is clearly recognized. With the knee flexed and bearing weight, a twist occurs. Since the meniscus is fixed between the tibial and femoral condyles, if excessive rotation takes place, something must give way. Sometimes this grinding force splits the substance of the meniscus, and from this primary tear secondary extensions may occur, producing the different varieties of torn meniscus. Precisely the same force may, instead, wrench the meniscus away from some of its peripheral attachments, thus producing the so-called rotation sprain. It is quite true that weight-bearing (and therefore a grinding force) is essential in the production of a split in the meniscus, whereas it need not be present for a rotation sprain to occur. The important point, however, is that the selfsame force may, on occasion, produce either type of injury; and therefore the history may not help in differentiation.

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The most important feature in the present-day method of examination for a meniscus injury is rotation of the tibia, while the knee is held in varying degrees of flexion, as, for example, in McMurray's test. This manoeuvre is calculated to displace a meniscal fragment and to produce the well-known click, which is palpable, constant in position, and recognized by the patient. Together with the history (which, although of the highest importance, is not dealt with in this paper), a diagnosis can usually be made. All too often, however, signs are absent, and there seem to be three disadvantages in this method of examination:

1. A click is not a truly reliable sign. Its cause may lie in a different knee injury or in a different joint entirely. Many surgeons fail to find it at all, although McMurray declares that the diagnostic click is reliably constant in his personal cases.

2. The routine method of testing by rotation must necessarily pull on those tissues damaged in a rotation sprain, so producing extraneous pain. Thus, in the very process of testing for a meniscus injury, the surgeon may actively confuse the picture.

3. The third disadvantage, as Platt has emphasized, is that the present method is based upon unstable mechanics. With the patient lying on his back and the surgeon examining his knee, there are two fixed points,—the pelvis, which rests on the bed, and the ankle, held in the surgeon's hand. Between these two, the long connecting levers of the thigh and the leg are unstable, and are not adequately steadied by the surgeon's hand.

A THEORETICAL SOLUTION

From the foregoing paragraphs it is evident that, in the examination of the knee, we are dealing with a confused problem of mechanics. To solve this problem, it must be resolved into its distinct components. First, stabilization of the levers can be accomplished by laying the patient on his face and fixing his femur in a way which will be described later. Second, to effect a diagnostic separation between meniscus and soft tissues, the application of a longitudinal stress is required. This stress should, alternately, be a separating (or distracting) force, and a compressing force; and these two types of longitudinal stress should be capable of easy application.
The various illustrations epitomize both the theoretical arguments and the practical tests. These tests are easy to demonstrate in the patient, but less so in print.

Figure 1 shows the theoretical result of applying separation or distraction to the knee. Clearly, the soft tissues are being stretched, while the meniscus remains undisturbed. (For simplicity, only the tibial collateral ligament is shown in the diagram, but the coronary fibers and the capsule must undergo similar stretching.) A test based on this fact is, therefore, a test of the soft tissues (ligamentous, fibrous, and capsular) and of these alone. Such a test would be positive in a rotation sprain.

Figure 2 illustrates the basis for a compression test. Here the soft tissues are clearly relaxed, but the meniscus itself is being crushed. In this position, in addition to the compression already produced, rotation can be added. This combination of compression and rotation constitutes a grinding force which is an accurate reproduction of the original destructive force.
in meniscus damage, so that a positive grinding test points unequivocally to meniscus injury.

Expressed in these simple terms, the two manoeuvres of compression and distraction form the basis of the proposed tests to fulfill the requirements previously put forward. It remains to translate these theoretical considerations into practice; and, to do this, a posterior method of examination is employed.

**THE POSTERIOR EXAMINATION OF THE KNEE**

For this examination the patient lies on his face. He should be on a couch not more than two feet high, or the tests become difficult, and he must be well over to the edge of the couch nearest the surgeon. To start the examination, the surgeon grasps one foot in each hand, externally rotates as far as possible, and then flexes both knees together to their limit (Fig. 3). When this limit has been reached, he changes his grasp, rotates the feet inward, and extends the knees together again. This preliminary manoeuvre demonstrates limited rotation, painful rotation, and the exact angles of flexion at which these occur; the estimation of these angles proves useful later in the examination.

The surgeon then applies his left knee to the back of the patient’s thigh (Fig. 4). It is important to observe that in this position his weight fixes one of the levers absolutely. The foot is grasped in both hands, the knee is bent to a right angle, and powerful external rotation is applied. This test determines whether simple rotation produces pain.

Next, without changing the position of the hands, the patient’s leg is strongly pulled upward, while the surgeon’s weight prevents the femur from rising off the couch (Fig. 5). In this position of distraction, the powerful external rotation is repeated. Two things can be determined: (1) whether or not the manoeuvre produces pain and (2), still more important, whether the pain is greater than in rotation alone without the distraction. If the pain is greater, the distraction test is positive, and a rotation sprain may be diagnosed.

Then the surgeon leans well over the patient and, with his whole body weight, compresses the tibia downward onto the couch (Fig. 6). Again he rotates powerfully, and again he asks two questions: (1) “Does it hurt?” (2) “How much does it hurt?” If the addition of compression has produced an increase of pain, this grinding test is positive, and meniscal damage is diagnosed.

Incidentally, this question of the amount of pain is not a matter of fine hairline distinction; the patient must be sure of a considerable difference, and indeed he usually is.

**THE USES OF THESE TESTS**

1. So far, attention has been focused on differentiating a meniscus injury from a rotation sprain. This is the first, and perhaps the most important, use of these tests. They
are also useful in other types of cases, however, in some of which it is necessary to introduce modifications.

2. In many patients the history lacks diagnostic precision and the common physical signs of meniscus damage cannot be elicited; the findings are vague, although the patients may be grossly disabled. Again, in many patients the diagnosis of a lesion of the posterior horn of the meniscus may be difficult. In both types of cases, surgeons are not unreasonably chary of operating in the absence of any single clear diagnostic feature in the history or the physical examination. Not infrequently, therefore, the patient limps his way, for months or years, with the aid of physiotherapy. There is, therefore, a second use for the tests; for, if the grinding test is positive, then the doubt as to the diagnosis (and incidentally the meniscus) should be removed.

With a suspected tear of the posterior horn, the grinding test is modified; instead of holding the leg at a right angle, the knee is flexed much more acutely. The importance is now apparent of determining, in the preliminary manoeuvre (Fig. 3), the angle of flexion at which pain is produced by rotation, for the test should always be repeated at precisely this angle. In this way it may be possible to obtain accurate localization of the meniscus lesion as well.

3. A third use of the tests is in the diagnosis of lesions of the lateral meniscus, which may also be difficult at times. For this purpose the tests are modified by rotating the foot inward instead of outward; in other words, a reverse grinding test is performed. The clue as to whether this is worth trying is again given by the preliminary manoeuvre, in which both rotations at all angles of flexion were performed.

LIMITATIONS OF THE TESTS

Any diagnostic test should be judged by three fundamental criteria: (1) It should be fairly easy to do; (2) it should be constantly positive for the precise lesion concerned; and (3) it should be negative for all other lesions.

The grinding test is not too difficult, but it does need a good deal of practice and careful attention to detail. The use of a low couch, the application of considerable force in compression and rotation, and carrying out the test at the suitable angle of knee flexion are all important points, the neglect of which may result in failure.

As to whether the grinding test is always positive with a meniscus lesion and the distraction test with a soft-tissue lesion, it is perhaps too early to say. This paper is being presented at a somewhat early stage in the hope that more widespread trials will follow. Since becoming accustomed to the tests, however, the author has been surprised by their constancy.

With regard to other lesions, the author has three times found the grinding test positive when there was a pedunculated loose body other than a split meniscus. This does not seem to be a serious drawback for, quite apart from the help afforded by roentgenograms, operation was no less indicated.

RESULTS

The results by these methods are shown in Table I. The number of cases is small because, in the great majority of cases, the orthodox methods established the diagnosis simply and firmly. These cases are therefore omitted, and only fifty cases remain. Broadly speaking, Groups A and B are those in which only the application of the new tests permitted a diagnosis to be made; whereas Groups C and D, especially Group D, are those in which the tests resulted in the correction of wrong diagnoses.

Group A consists of ten cases. In none was there a history typical of meniscus injury, and in none was a single positive physical sign found by orthodox methods. In all ten, however, the grinding test was clearly positive, and in each a split meniscus was removed at operation.
TABLE I

RESULTS

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Cases</th>
<th>Typical History of Meniscus Injury</th>
<th>Positive Meniscus Tests</th>
<th>Diagnosis</th>
<th>Findings by Orthodox Methods</th>
<th>Findings by New Methods</th>
<th>Actual Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>No meniscus lesion</td>
<td>10</td>
<td>0</td>
<td>Split meniscus at operation</td>
</tr>
<tr>
<td>B</td>
<td>13</td>
<td>Variable</td>
<td>0</td>
<td>Probably no meniscus lesion</td>
<td>13</td>
<td>0</td>
<td>Split meniscus found at operation</td>
</tr>
<tr>
<td>C</td>
<td>15</td>
<td>Variable</td>
<td>0</td>
<td>? Split meniscus</td>
<td>0</td>
<td>15</td>
<td>Rotation sprain</td>
</tr>
<tr>
<td>D</td>
<td>9</td>
<td>Fairly good</td>
<td>3</td>
<td>Probably a split meniscus</td>
<td>0</td>
<td>9</td>
<td>Rotation sprain (not proved)</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>Miscellaneous cases for discussion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Totals</td>
<td></td>
<td></td>
<td>23</td>
<td>24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In the thirteen cases of Group B, orthodox physical examination was again negative; but the histories varied from complete vagueness to more or less definite hints of meniscus damage. Again, however, the grinding test was constantly positive; and in these cases, too, a split meniscus was removed at operation.

In a few of the cases in Group B, the history alone might possibly have led to operation. This links up with Group C, for in the fifteen cases of this group, there was a similar variability and vagueness in the history, coupled with absence of orthodox physical signs. To all appearances, therefore, Groups B and C are alike. In all the cases of Group C, however, the distraction test was positive, and a diagnosis of rotation sprain was therefore made.

Group D carries the argument a stage further, for it consists of nine cases in which the history definitely was suggestive of meniscus damage; moreover, in three of them a positive McMurray's sign was probably obtained. Again the grinding test was negative and the distraction test positive, and a rotation sprain was therefore diagnosed. With this diagnosis, in Groups C and D operation into the joint was not indicated. In a few cases negative air arthrograms were obtained, but the results with this method are insufficiently constant to afford proof. Purely conservative methods, including manipulation in some, appear to have justified the diagnosis. It is not unlikely that, without these tests, at least the three cases mentioned, and probably several more of this group, would have come to operation, and that normal menisci would have been removed. Here, then, are cases with an apparent diagnosis of meniscus damage, which were actually examples of rotation sprain. It is impossible to resist the speculation that this may provide the explanation for some of those enigmatic cases in which normal menisci are removed.

Group E consists of three miscellaneous cases. In one, the diagnosis of split meniscus was made on the basis of the history, a positive physical examination by orthodox methods, and also a positive grinding test; nevertheless a normal meniscus was removed. The remaining two cases had previously had meniscectomy; and, in both, a fragment of the posterior horn remained, diagnosed by the positive grinding test. They also showed a positive distraction test, however,—a curiosity explained by the presence of postoperative adhesions mimicking rotation sprain. Thus an apparent contradiction proved, in fact, to be confirmatory evidence of the validity of these tests.

One curious case was seen. The patient had a reasonably suggestive history and a very obvious McMurray's sign. When the grinding test was performed, and compression...
and rotation were applied, there was a sudden click. Much to the patient’s surprise, and somewhat to the author’s, the knee was locked. To satisfy himself, the author locked and unlocked it three times in all. Fortunately this was not a very painful process; and it does seem to suggest that, in the grinding test, the correct type of force is being used.

**SUMMARY**

Some new tests for the diagnosis of meniscus injury, and its differentiation from rotation sprain, have been described. These tests aim at separating the individual components in knee-joint injury, and at reproducing the causal grinding force of meniscus damage. With wider experience, it is hoped that they may help to reduce the percentage of errors in the diagnosis of knee-joint injuries.

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**REFERENCES**