OSTEOCHONDRITIS DISSECANS OF THE ELBOW JOINT

A Clinical Study

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The term osteochondritis dissecans is used in this paper to describe an apparently non-infective condition in which a portion of articular cartilage and underlying bone is slowly separated from its bed. The separation, which is at first partial, may be completed with the formation of one or more loose bodies.

It is commonly believed that the incidence of osteochondritis dissecans in the knee is very much higher than in any other joint; according to Conway (1937) the knee is affected in 85 per cent of cases. The British and American literature has only scant and isolated reference to incidence in the elbow joint, where the condition is regarded as somewhat of a rarity (Murphy 1936). Continental writers, on the contrary, have for the past twenty years recognised a higher incidence in the elbow than in the knee (von Staa 1930, Lohr 1929). We believe that in this country the condition is no less common, and our purpose is to record its main features as we have found them in a study of thirty-eight cases.

CLINICAL MATERIAL

During this investigation, the records of over ninety unselected cases of loose body in the elbow joint were studied from hospitals in the Liverpool area. Reviewing the operation records of twenty years at the Liverpool Royal Infirmary, we found that arthrotomy for loose body was far more frequently performed on the elbow than on the knee. In selecting cases for review we were at pains to exclude all doubtful cases and, when loose bodies have been the presenting feature, care has been taken to exclude other possible causes. Thirty-eight cases (forty-four elbows) were accepted as undoubted cases of osteochondritis dissecans.

CLINICAL FEATURES

Age at onset—A distinction must be made between the age of the patient at onset of the condition and the age at which he first seeks advice. The onset of the disease is variable but occurs principally in the second decade (Meyer-Wildisen 1932, 14–18 years; von Staa 1930, 15–22 years; Lohr 1930, 16–20 years), and in general at a much younger age than osteochondritis dissecans of the knee. The youngest patient in our series was eleven years of age; the highest incidence was at fourteen to fifteen years; a later onset, at nineteen or twenty, was seen occasionally. Schirmer (1925) described a case of osteochondritis dissecans in a man aged fifty-three years as “early.”

Sex—There is a marked preponderance of the male sex—85 to 90 per cent in the published literature (von Tempsky 1930, von Staa 1930 and Kappis 1920). All but three of our thirty-eight patients were boys.

Affected side—In the unilateral cases the right elbow was involved twenty-seven times and the left five times. In six cases the condition was bilateral. Thus the right side was involved in 75 per cent of the total number of elbows affected. This striking predilection for the right elbow has been found by other writers (Christensen 1930, Kappis 1920, Schirmer 1925 and Tempsky 1930).

Symptoms—The clinical picture of the early case is very variable. Often the patient first complains of a diffuse dull pain or ache in the joint accompanied by a little stiffness; the

onset is insidious. Attention may be drawn to the condition by recent injury; a history of trauma was obtained in 41 per cent of cases, but in nearly all these we considered the injury was either too recent, too trivial or too remote to be relevant. The first symptom is often that of a loose body in the joint, and sudden spontaneous locking followed by pain and effusion in the elbow of an adolescent is pathognomonic of osteochondritis dissecans. Finally we would stress that the condition is often symptomless and discovered accidentally: so-called "slumbering" osteochondritis dissecans is, indeed, probably far commoner than is suspected.

Signs—The most constant early physical signs are limitation of extension of the elbow and palpable enlargement of the head of the radius. The absence of conspicuous synovial swelling distinguishes the condition from chronic infective lesions, particularly tuberculosis.

RADIOGRAPHIC FEATURES

Site—The site of the lesion cannot be determined by clinical examination. In this series, radiography revealed a lesion either in the capitellum (forty elbows), in the head of the radius (two elbows), or in both (two elbows). It has been suggested (Morton and Crysler 1945, Ross 1947) that the supratrochlear septum may be the site of a primary lesion. It is true that a loose body may be found in a pit either in front of or behind the septum, but no case has been recorded in which the actual process of separation from this situation has been observed. Neither the olecranon nor the coronoid fossa is covered by articular cartilage, and in all Crysler's cases the loose bodies were shown to be covered by hyaline articular cartilage; furthermore, in at least one of their cases the published radiographs show clearly the enlargement of the head of the radius and flattening of the capitellum, which we associate with a previous lesion of the radio-humeral articulation. We conclude that the evidence for the occurrence of a primary lesion in the supratrochlear septum cannot be accepted.

Early changes: *The capitellum*—The so-called typical appearance of an island of subchondral bone surrounded by a zone of rarefaction, which is so often seen in the knee, hip and ankle, is rarely seen in the elbow; we have only one case in this category. Excellent illustrations of such a lesion have been published by Williams (1939) and by Miller (1936). Castay (1936) described a similar lesion but published no illustrations. In our experience the earliest changes are seen in the antero-posterior radiograph as a patchy rarefaction, with ill-defined limits,

FIG. 1

Early osteochondritis dissecans of the capitellum in a boy aged nineteen years. A single loose body was subsequently removed.

largely affecting the convexity of the capitellum (Fig. 1). The super-imposition of normal bone probably modifies the appearance. Less often the lesion is more easily seen in the lateral view (Fig. 2). The next most constant appearance is an irregular cyst-like change, which has been aptly likened by King (1932) to a series of signet rings of different sizes opening into the focus bed (Figs. 3 and 4), and which, as Burrows (1949) has pointed out, bears a resemblance to an early stage of Freiberg's disease of the metatarsal head. We believe that this represents a later, more defined phase of the patchy rarefaction, and that the separation of small fragments may now become evident. The shedding of multiple small

FIG. 2

Early osteochondritis dissecans in the right elbow of a boy aged fifteen. Flattening and irregularity of the capitellum are seen in the lateral view. Two loose bodies were later removed, one of which was completely detached and the other a hinged flap.

FIG. 3

FIG. 4

Figure 3—Osteochondritis dissecans with early change in the capitellum and head of radius. The patient was a boy aged fifteen complaining of pain and loss of extension in the right elbow. Figure 4—The same case nearly two years later. There is now extensive ragged destruction of the capitellum. At operation one completely detached loose body and a large hinged flap of articular cartilage were removed. The opposite elbow also developed osteochondritis dissecans with loose body formation.

fragments giving a ragged appearance is sometimes seen (Fig. 5). Yet another picture demands special description, namely the occurrence of a single, large, rarefied or punched-out area or cavity without any apparent sequestrum, very closely simulating the destruction of tuberculosis (Fig. 6). This diagnosis was, in fact, made in two such cases in our series, and disproved only by the subsequent progress. Somewhat similar cases have been illustrated by Christensen (1930). Sometimes a loose bone fragment is seen to lie close to its capitellar bed (Fig. 7). *The head of the radius*—In two patients in whom the major change was in the capitellum, irregularity and cyst-like changes were also observed in the head of the radius

FIG. 5

Extensive destruction of the capitellum, marked enlargement of the head of the radius and formation of multiple loose bodies in the case of a girl aged fourteen years. The radiograph of the normal elbow is shown for comparison.

FIG. 6

The radiograph shows the right elbow of a boy aged fourteen, complaining of pain and limited extension. The capitellum shows a punched-out area; a large sequestrum of articular cartilage was removed.

(Fig. 3). In two other patients the lesion was confined to the head of the radius, and three identical cases have been reported by Nielsen (1931). The affected portion is the medial part of the convex rim of the radial head. Figure 8 shows such a lesion, and the radiographic appearance of the excised head is also shown. There is a separate bony fragment still covered by intact articular cartilage, and deep to this is an irregular cyst-like change affecting a wedge-shaped sector of the head. The appearance is very similar to that noted by Wolbach in osteochondritis dissecans of the knee (Jones and Lovett 1929).

Late changes—Whatever the original form of the lesion may have been, in the vast majority of cases presenting with loose bodies careful scrutiny of the radiographs will reveal the scars which are the hallmark of previous osteochondritis dissecans. The cyst-like appearance may remain (Fig. 9), or the eburnated irregular margins of the primary lesion may be seen in profile (Fig. 10), but the most constant feature of all is a flattening of the capitellum (Fig. 11).

FIG. 7

The right elbow of a boy aged fifteen years; a radiograph of the normal side is shown for comparison. On the affected side there is irregular destruction of the capitellum and a detached loose body. Note the premature fusion of the lower humeral epiphysis and of the head of the radius.

FIG. 8

Osteochondritis dissecans of the head of the radius in a boy aged sixteen years who had previously been operated on for osteochondritis dissecans of the capitellum on the opposite side. The radiographs show the appearance before operation and the state of the excised head.

This we have found to be present in 68 per cent of cases. It is also occasionally seen in normal elbows: in a group of fifty-four normal elbows flattening of the capitellum was noted in five (three persons). There are thus many patients, first reporting in the third decade, who have suffered from osteochondritis dissecans in an undetected form several years previously, and whose first important symptoms arise from the locking of a loose body. Secondary osteoarthritis commonly develops at a later age and may be wrongly regarded as the cause rather than the result of loose bodies. If the osteoarthritic changes are severe it may be difficult to distinguish between a primary osteoarthritis and one secondary to a previously undetected osteochondritis dissecans. The general distortion of the shape of the joint which occurs in severe osteochondritis dissecans does not limit itself to the capitellum and the head of the radius. As noted by King (1932), the greater sigmoid cavity of the ulna may be enlarged and deepened with a curious angular appearance (Fig. 12).

FIG. 9

A late case of osteochondritis dissecans, showing an irregular flattened capitellum, an enlarged head of radius and a single large loose body.

FIG. 10

Right elbow of a man aged twenty-seven. A large loose body in the olecranon fossa is of the type said to arise from the supratrochlear septum. Note the pit in the capitellum from which the loose body has come.

FIG. 11

A late case of osteochondritis dissecans. Comparison of the affected and the normal elbow shows the enlargement of the head of the radius, irregular flattening of the capitellum, and loose body formation. Further loose bodies were seen in the lateral view, and twelve were removed at operation.

It should be mentioned before concluding the account of the radiographic changes that they must not be confused with those of the entirely different and rare condition of multiple epiphysial dysplasia. In this there may be distortion in shape of the radio-humeral articulation but the changes are not superimposed on a previously normal elbow.

ASSOCIATED CHANGES

Enlargement of the head of the radius—The head of the radius was unmistakably enlarged in 50 per cent of the cases we studied. Löhr (1930) goes so far as to say that all cases exhibit this enlargement, but it should not be recorded too readily, because apparent enlargement has often been disproved on actual measured comparison with the normal side. The enlargement is characteristically postero-lateral, and, if the radial epiphysis has not fused, the metaphysis is often of an accentuated funnel shape (Fig. 13). The enlargement may occur before or after closure of the epiphysis. The degree of enlargement has not been shown to be proportional to the altered contour of the capitellum. It is unlikely to be related to disturbance at the epiphysial plate, as suggested by Löhr, because growth here is entirely longitudinal and the epiphysis itself grows by circumferential accretion. It is possible that laxity of the capsule, by removing a restraining influence, may lead to enlargement of the head of the radius. We have found that enlargement of the head of the radius may occur from causes other than osteochondritis dissecans, for example after T-shaped fractures and subluxations of the head. It would appear that at least some of the enlargement occurs at the expense of the overlying cartilage, which becomes thin and purple in colour but is smooth and regular, without the marginal "cuffing" found in osteoarthritis. In long-standing cases the regularity may be lost and the head assume the most grotesque deformity (Fig. 14). **Epiphysial prematurity**—Löhr has studied at some length the epiphysial changes associated with osteochondritis dissecans of the elbow. He believes that there is a premature fusion of the lower humeral and upper radial epiphyses; further, that in contrast with the usual sequence, fusion always begins on the lateral aspect and proceeds medially, and that these changes occur after the first sign of osteochondritis dissecans in the capitellum. It is well known that injury to the elbow accelerates the appearance and development of the ossific nuclei, as substantiated by Bauman, but Löhr is careful to distinguish this from premature fusion of the epiphysis which, he says, does not occur after any injury other than crushing of the cartilage plate. The growth stimulation of injury may act over a period of many years and cause a considerable enlargement of the bone ends involved, but the pattern of fusion is not disturbed. In osteochondritis dissecans, the local growth stimulus acts only over a brief period near puberty, and causes no great enlargement.

We have studied the development and fusion of the elbow epiphyses in normal children between the ages of nine and fifteen, and like other observers have found a considerable individual variation in the age at which the ossific nuclei appear and at which the epiphysial lines fuse; but, although there is often a discrepancy between the maturity of the ossific centres on either side, there is rarely any difference in the time of epiphysial closure. In our experience fusion of the lower humeral epiphyses is found to be well advanced in most children at fifteen years; the opportunities of confirming the disturbances of epiphysial behaviour are therefore limited, because of the age at which most of these patients first attend. Only three cases in our series showed this premature epiphysial closure, and it is interesting that one case showed a marked difference in epiphysial maturity of the elbows with a little enlargement of the head of the radius on the more mature side, but no other abnormality when first seen (Fig. 13). Five years later the more mature elbow showed gross destruction of the head of the radius with irregular cyst-like changes in the capitellum, which, however, had not progressed to the formation of loose bodies (Fig. 15). Figure 7 also illustrates a case of premature epiphysial fusion.

FIG. 12

Lateral view of the same case as Figure 5 to demonstrate distortion of the upper end of the ulna, in addition to changes in the capitellum and head of radius. This feature is observed only in severe cases.

FIG. 13

The affected and the normal elbow in a boy aged fourteen years. The enlargement of the head of the radius is well shown; there is marked prematurity of the epiphyses at the lower end of the humerus.

FIG. 14

A late case demonstrating the grotesque distortion of the head of the radius which may sometimes occur.

FIG. 15

The same case as Figure 13, five years later, with irregular cyst-like change in the capitellum. No actual loose body has yet been found.

Multiple joint incidence—Bilateral involvement of the elbow has already been mentioned. It also occurs in the knee, with symmetrical involvement of the patellae or femoral condyles (Blanco 1921, Wagoner and Cohn 1931, Bernstein 1925). Watson-Jones (1943) quotes a case in which osteochondritis dissecans was present in both elbows and both knees, and Walter (1926) describes a case involving both knees and one elbow. Mr Geoffrey Hyman and Mr Robert Roaf have kindly allowed us to publish particulars of two similar cases in which multiple joints were involved.

Case 1—Mr Hyman's case. A boy aged eighteen years complained that for a few weeks he had noticed an aching pain in the left hip after vigorous exercise. Radiographs showed distortion of each femoral head with symmetrical separation of single loose bodies (Fig. 16). It was later discovered that he had had spontaneous locking of the left elbow five months previously, and radiographs revealed bilateral and typical osteochondritis dissecans of the capitellum, with loose bodies and enlargement of the head of each radius (Fig. 17).

FIG. 16

FIG. 17

Case 1. Figure 16—Lateral views of both hips in a boy aged eighteen years, with symmetrical osteochondritis dissecans of the head of each femur. Figure 17 shows osteochondritis dissecans of the right elbow with loose body formation. Similar changes were present in the left elbow.

Case 2—Mr Roaf's case. A girl aged eleven years, with general dwarfism of obscure origin, complained of pain and limited extension of the right elbow six days after an injury. The head of the radius was palpably enlarged and extension of the elbow was limited. Radiographs of the skeleton revealed bilateral osteochondritis dissecans of the patellae and medial femoral condyles with similar changes in both elbows (Figs. 18 and 19).

The significance of multiple joint involvement was not appreciated until late in our investigation, and a more complete radiological examination might well have revealed other lesions.

Hereditary factor—No hereditary or familial factor was recorded in any of our own cases. Wagoner and Cohn (1931) described osteochondritis dissecans of the knee in a father, son and paternal uncle; and bilaterally in two brothers, although the evidence in one knee was doubtful. Bernstein (1925) described bilateral affection of the knee in two sisters and their brother.

FIG. 18

FIG. 19

Case 2—Multiple osteochondritis dissecans in a girl aged eleven years with dwarfism. Each knee had two lesions, one of the inner femoral condyle, and the other of the patella; there were also changes in both elbows.

OPERATIVE FINDINGS

The operative findings vary according to the type of lesion, but the usual appearance is that of an untidy and ragged change involving a large area of the capitellum. There is frequently a hinged flap of articular cartilage overlying a fairly deep crater in the bone. Multiple loose bodies are commonly found. Some of these may have been revealed in the radiograph before operation because they contained a fragment of bone, or have become calcified, but the smaller ones consist of articular cartilage only, and, if they have been free in the joint for any length of time, become rounded in shape. Only one patient with a lesion in the head of the radius underwent operation; the irregularity of the convex margin was noted before excision of the head, but there was no actual break in the articular surface.

In the later cases loose bodies may be removed from some other part of the joint without exposure of the primary lesion; if the capitellum and head of the radius are seen, they are found to be irregular and roughened with the beginning of secondary degenerative change. Sometimes the indication for operation in these cases is excision of the radial head, to improve radio-ulnar movement, rather than removal of a loose body.

TREATMENT

A review of the literature indicates that the general opinion is against early operative intervention. The fate of an incompletely detached fragment of articular cartilage or a hinged loose body cannot be forecast, and when the elbow is exposed at operation in an early case there is a great temptation to remove partly detached fragments as well as the loose bodies. If these fragments were left in place, it is possible that they might survive and help to reconstitute a better articular surface for the capitellum. In the knee it is known that conservative treatment with splintage of the joint for a lengthy period may encourage the reattachment of a potential loose body (Dwyer 1950). In the elbow there is a danger that long-continued immobilisation may cause stiffness. In the early cases, therefore, the middle course appears to be best: the elbow should be rested in a sling, but allowed some freedom for movement; operation should not be undertaken.

At a later stage the indication for surgery becomes more definite. The loose bodies have become detached and there are good reasons for their removal. Operation will not necessarily involve any exploration or surgical attention to the primary site of detachment. The incision or incisions will be planned without regard to any exploration of the capitellum or head of radius, and will be made for the loose bodies themselves. The only further indication for surgical treatment is that, if the head of the radius is much enlarged and there is roughening and degenerative change between the head of the radius and capitellum, excision of the head of the radius may be called for to improve radio-ulnar movement. This indication is not likely to arise in the more severe cases with general distortion of the shape of the joint; some permanent disability is likely to remain whatever is done surgically for such patients.

DISCUSSION

The main etiological theories of osteochondritis dissecans are too well known to justify repetition here; they have been enumerated with faithful constancy and in great detail in most published works on the subject. The cause of osteochondritis dissecans is not known. It may even be that its cause is to be found in more than one condition, but the theory which takes cognisance of the greatest number of established facts will convince us most. Among such facts demanding explanation we would include particularly: 1) the history of mild injury in nearly half the cases; 2) the overwhelming preponderance of males; 3) the tendency for multiple loose bodies to be formed—not all at the same time; 4) the radiological picture of patchy rarefaction followed by cyst-like change underlying separated fragments; 5) the

limitation to convex articular surfaces—head of femur, capitellum, convex borders of head of radius and talus; 6) the onset in adolescence; 7) the multiple joint involvement, including bilateral cases; 8) the association with epiphyseal prematurity; and 9) the predilection for the right side in the case of the elbow.

The role of injury is admittedly difficult to assess. Osteochondral fractures undoubtedly lead to loose bodies but, being intra-articular, these are injuries severe enough to produce effusion, and are likely to be remembered. Such was not suggested by the histories in our cases. Attention has been drawn to the effect of repeated minor injury, for example, the "baseball elbow" (Bennett 1941), but we are not at all convinced that this is in any way related to osteochondritis dissecans of the elbow. In this connection it is worthy of note that of 828 pneumatic-drill workers suffering from an occupational disability of the elbow joint only seven had osteochondritis dissecans (Rostock 1933). A history of injury can be obtained in most cases of tuberculosis of the limb joints, but none would deprive the tubercle bacillus of the major role; it is our belief that the place of injury in osteochondritis dissecans of the elbow is secondary, rather than primary as suggested by Fairbank (1933).

The evidence for a general or constitutional factor is much stronger. The patients are at an age when hormonal balance is precariously set, when epiphyses mature and fuse, and when they are prone to vascular and mechanical disturbances. Silberberg and Silberberg (1946) have demonstrated experimentally the effect of androgens on epiphyseal maturity in male and female mice; Harris (1950) has shown the effect of testosterone on the strength of the epiphyseal junction; and Schaefer *et al.* (1939) have emphasized the high incidence of epiphyseal disturbances in endocrinopathic patients. The role of the endocrines in the normal control of bone and cartilage growth presents a complex and somewhat confusing picture. Nevertheless we think it likely that the explanation of the male preponderance, the epiphyseal prematurity and the multiple joint involvement in this condition will be found in a better understanding of the hormonal and constitutional influences on skeletal growth.

It is interesting to compare the male sex preponderance with that of Perthes' disease of the hip (75 per cent, Brailsford 1948). In this condition, too, circumscribed osteocartilaginous areas may become sequestered as described by Mroz (1932) and we ourselves have records of three such cases, the picture being indistinguishable from osteochondritis dissecans. In this connection, attention may be drawn to osteochondritis juvenilis of the capitellum, a condition usually discovered accidentally, and with the greatest incidence at about eight years of age. Of the ten recorded cases in the literature, nine were in boys—one of whom had an associated Perthes' disease of the hip. (We have encountered two such cases with involvement of both hip and elbow in the last year.) The few cases which have been followed up over a period of years have shown complete restitution of the capitellum with symptomless and clinically normal elbows. It is conceivable that some cases of osteochondritis juvenilis of the capitellum do not progress to complete restitution, and that, as in the case of its counterpart in the hip, a localised osteocartilaginous portion becomes sequestered; one recalls that when loose bodies follow Perthes' disease of the hip, symptoms are not usually manifest before adolescence.

In considering the local changes we would confirm our belief in the view originally expressed by Wolbach and Alison (1928), and later stressed by Ghormley (1932) and Conway (1937), that an alteration in the architecture of the bone with cyst-like formation in the presence of intact overlying cartilage precedes the formation of loose bodies.

In conclusion, we believe that evidence of a constitutional factor is strong, but that the predilection for certain joints, for the right elbow, and for convex articular surfaces, can only be explained on the basis of a local factor. Thus we are tempted to support a concept of two main factors: an overriding constitutional factor which determines the onset of the condition, and one or more local factors which determine the particular anatomical site of the lesion. In rare cases the constitutional factor is so marked that almost any convex articular surface

may be affected, but in most cases one must assume that the factors are more finely balanced, with consequent affection of one or two joints only.

We wish to acknowledge very generous help from many sources during the last two or three years. Our colleagues in Liverpool and elsewhere have kindly made available to us records and radiographs of interesting cases, and we have also received much valuable assistance in the translation of articles. Nurses and radiographers have responded nobly to the extra calls upon their time involved in the survey and other investigations. We should especially like to record our indebtedness to Sir Thomas Fairbank, Mr F. C. Dwyer, Mr G. Hyman, Mr B. L. McFarland, Mr R. Roaf, Mr H. J. Seddon and Mr Goronwy Thomas.

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