TREATMENT OF OSTEOCHONDRITIS DISSECANS

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It has been known for more than a decade that osteochondritis dissecans of the knee joint in children will heal with rest or even spontaneously (Decker 1938, Wiberg 1941, Strange 1944, Smillie 1946, Van Demark 1952, Green and Banks 1953). This capacity is lost with maturity and may not extend beyond adolescence (Wiberg 1943). Current treatment thereafter consists of symptomatic removal of the loose bodies which separate into the joint; and months or years later, of palliative measures directed to the pain of the osteoarthritis which develops in lesser or greater degree depending on the size and location of the lesion and the physical demands of occupation.

This paper records the experience of an attempt to treat osteochondritis dissecans in a more idealistic way. It confirms the possibility of healing in children by conservative means. It proposes to show that timely operative intervention can prevent separation of fragments and result in healing. Finally, it proposes to show that timely operative intervention can restore the anatomy of the part and result in healing even after fragments have separated.

COMPARISON WITH FRACTURES

Although it is axiomatic that treatment be related to cause, it is not intended on this occasion to re-enter the controversy about the etiology of this mysterious condition; but the reader’s indulgence is sought for an over-simplification of the situation if the lesion is regarded as a fracture in order that the principles of fracture treatment can be applied.

It is characteristic of osteochondritis dissecans of the knee that the many stages in the pathological anatomy which exist, before the last isthmus of cartilage or ligament gives way, are represented by not dissimilar radiological appearances. But whether the overlying articular cartilage is intact, as it may be, or indented, or soft and raised above the surrounding surface, or partly separated, the feature common to all is an area of horizontal cleavage in the superficial layers of the underlying bone. The horizontal cleavage represents the fracture line. It probably originally contained blood, but in the absence of immobilisation it does not heal but proceeds through the various stages of delayed union to established non-union. In the final act, the smaller fragment, consisting of dead bone but live articular cartilage, is cast into the joint as a loose body. Osteochondritis dissecans, however, differs from other fractures in that it is never seen in the recent state. Unfortunately, the symptoms, at all stages save the dramatic locking of the final loose body, are ill-defined and transient; years may pass before the patient gives the opportunity for diagnosis. Treatment is thus determined by the stage at which the fracture is presented. Each demands different methods comparable with those in current use whereby delayed union is treated by rest, possibly supplemented by some method of improving local blood supply; established non-union by freshening of the bone ends, possible internal fixation to maintain alignment, and rest.

SPONTANEOUS HEALING

There are numerous references in the literature to spontaneous healing with a variety of interpretations of the meaning of spontaneous. “Treatment” in these “spontaneous” cases has varied from limitation of activity (Wiberg 1941) to plaster immobilisation (Van Demark 1952) or even complete bed rest for six months (Decker 1938). While it is recognised that true spontaneous healing can occur, and indeed is in keeping with the fracture analogy propounded, it is probably unwise to take no more action than to keep a child under observation for the two years (Wiberg 1943) to seven years (Green and Banks 1953) required.
when methods of therapy exist from which a return to radiological and clinical normality can be expected in a relatively short time. Further, if it is accepted that the condition heals spontaneously, or by immobilisation alone, it must also be accepted that a point may be reached in the pathological anatomy when the process is irreversible. Observation may be dangerous; but the younger the child the greater the tendency to return to normal and the less will be the risk.

True spontaneous healing was not observed in this series.

**TABLE 1**

**SEX AND AGE OF PATIENTS TREATED BY THE THREE METHODS DESCRIBED, AND SITE OF LESION**

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**IMMOBILISATION**

It is probable that no treatment except immobilisation would be necessary in osteochondritis dissecans if the diagnosis could be made early enough; but the very features on which the radiological diagnosis is based, namely, relative density of the bony element of the fragment, or sclerosis of the base of the crater, indicate that the condition has existed for some time. Sufficient operative experience has been accumulated to indicate that the possibilities of healing by immobilisation alone are limited. In these circumstances, it is not proposed to attempt to define the indications for conservative treatment, but to record that three cases, treated ten years ago, healed in from three to six months. In each, the patient was relatively young, the lesion small and the sclerosis minimal. In a further two, immobilisation was not deliberate; it occurred incidentally in small symptomless lesions noted in the course of routine radiological investigation of recurrent subluxation of the patella. On completion of the treatment of this, the osteochondritis dissecans lesions were noted to be healed.
BACKGROUND TO REPARATIVE MEASURES

Drilling—At certain stages in development, before the loose body is discharged into the joint, the lesion has all the radiological appearances of an ununited fracture, with opposed surfaces of sclerotic bone and an intervening clear space. In the ordinary ununited fracture the radiological clear space represents dense fibrous tissue. In osteochondritis it is an actual space; and yet the overlying articular cartilage may be intact or merely depressed as a result of loss of support from absorption of bone. This is the type of case to which an operation to produce a fresh blood supply to both sides of the fracture, but with the minimum of interference with the overlying articular cartilage, is particularly applicable.

Multiple drilling of opposed sclerotic fragments in an ununited fracture in order to introduce a new blood supply has been practised since before the first world war (Wilday 1915). The method has gradually fallen into disfavour in the face of newer and much more certain methods of promoting union. There are, however, special circumstances in osteochondritis dissecans which make the method applicable, in particular the absence of a barrier of dense fibrous tissue between the fragments. The penetration from without inwards of the small fragment through the sclerotic zone of the condyle to a source of blood supply can be expected to result in the filling up of the entire space between the fragments with blood clot, which would be transformed into granulation tissue by capillaries growing out from the host and thus form a source of blood supply for the dense bony fragment.

Drilling and internal fixation—The follow-up of cases from which a massive loose body, consisting of a large part of the weight-bearing surface of the medial femoral condyle, has been removed provided the stimulus to attempt to repair the defect. The result of operation, even had it failed, could not have been worse that the disaster that occurs in any event. But there was no reason to expect failure. The articular cartilage of a loose body is alive and
proliferating; the bony element no more dead than before discharge into the joint; and it was known that before separation it could be revascularised from a suitably prepared bed.

The original case of the series in which the loose body was retained and healing occurred

\[\text{Fig. 3} \quad \text{Case 25. Figure 3—The crater.} \quad \text{Fig. 4—Articular cartilage at exploration fifteen weeks later. Replacement is imperfect; but the screw has provoked no reaction.}\]

\[\text{Fig. 5} \quad \text{Case 25—Radiograph immediately after replacement of the loose body and fixation with Vitallium screw.}\]

has been recorded before (Smillie 1951). It was appreciated at that time that the risk of redisplacement after operation had not been eliminated and the possible use of internal fixation was proposed.

\text{VOL. 39 B, NO. 2, MAY 1957}
In the first case in which internal fixation was used, the loose body, which was of massive type, had been free in the joint for six weeks and it had to be pared down to fit the crater. Some form of fixation was essential, and it was effected by means of a single Vitallium screw. Fifteen weeks later, when the density of the fragment approached that of the surrounding bone, the joint was reopened to remove the screw. At operation it was seen that healing was complete, but there was some irregularity of contour from depression of one extremity below the general surface. The screw had provoked no reaction.

In the second case of the same massive type, greater difficulties of accurate replacement were encountered because of tissue loss. A screw was again used for fixation. At re-exploration the lesion had healed but the fit had not been quite accurate and the impression was gained that some absorption of articular cartilage had occurred adjacent to the small raw areas of bone which had been left exposed. The appearance of thinning of cartilage adjacent to an abnormal source of blood supply determined the decision early in the series not to use bone grafts or other reaction-promoting material as a means of internal fixation. The screw had provoked no detectable reaction (Figs. 1 to 7).

It was at this stage that it was realised that a screw, while possessing certain advantages, was not the ideal method of fixation. It is difficult to introduce and indeed the lesion may be in such a position that insertion is impossible. Further, once the screw is inserted no adjustment of alignment is possible. Consequently, in the third case, in which two large fragments were present, small pins, like the common commercial pins used in cloth but constructed of stainless steel wire, were used. Although they served the purpose, they were unsatisfactory in that a tendency to bend made them difficult to insert and when removed they were found to be eroded immediately distal to the heads, presumably because of the heat used in manufacture.
In the fourth, and in all six subsequent cases, stainless steel nails, one or one and a quarter inches long and of one-sixteenth of an inch in diameter, without heads but with a groove at the extreme proximal end to facilitate removal, were used (Fig. 13). The nail is held and inserted with a hollow punch incorporating a depth indicator. The final driving home is accomplished with a punch so constructed as to avoid damage to the articular cartilage (Fig. 8).

**TECHNIQUE OF OPERATION**

The operation is performed under tourniquet with the knee flexed over the end of the table as for excision of a semilunar cartilage. The incision is that used for removal of the medial cartilage (Smillie 1946), slightly enlarged in both directions but avoiding the infrapatellar branch of the saphenous nerve. The non-destructive nature of the approach is stressed. The procedure is justified only if the exposure used is innocent of permanent impairment of function. Access to the classical site varies with sex, conformation, and size of fat pad. Consequently the use of the three sizes of long-bladed knee joint retractor (Smillie 1946) is recommended. Division of the anterior and antero-central attachments of the semilunar cartilage should, if possible, be avoided.

The next step is determined by the nature of the lesion:

1. The loose body is quite free, as in the uncommon massive variety, or lying in the intercondylar notch attached by a few strands of posterior cruciate ligament, as frequently occurs at the classical situation. In these circumstances the crater is prepared by excising any fibrous tissue that may line the margins and by drilling the base. In the latter measure the sclerotic bone will be found to be much harder than expected and time will be saved by the use of a fine-pointed gouge and hammer. If the loose body retains a ligamentous attachment this is preserved and any drilling of the bony element carried out within the joint using a fine sharp-pointed instrument such as a length of Kirschner wire. If the loose body is free the facility with which it can be replaced is not unnaturally related to the interval between displacement and operation. Paring of the proliferating margins must take place outside the joint; and the only means by which it can be held without damage is the gloved forefinger and thumb moistened with sterile saline. After paring, the fragment is returned to the crater and adjusted to the surrounding surface as accurately as possible. The direction in which the nail is inserted is determined to a large extent by the position of the lesion and by the access available. It cannot always be driven at right angles to the surface. Occasionally a second nail may be necessary. If the semilunar cartilage has been detached it is replaced and the fine catgut sutures are buried within the fat pad (Figs. 9 to 15).

2. The loose body has not separated but is outlined by granulation tissue protruding through a recent fissure, or by fibrous tissue lining a well established gap; the body is attached laterally by tags of posterior cruciate ligament and medially by an isthmus of intact articular cartilage. In these circumstances a decision must be made whether to leave the potential loose body undisturbed and treat by drilling alone, or to divide the isthmus of cartilage and hinge the loose body laterally on the ligamentous attachment in order to gain access to all aspects of the lesion. The choice will depend on local conditions. So far, the latter method has been favoured as less destructive of articular cartilage and more certain of success even if it did entail the use of internal fixation.
Case 28—Radiographs to show site and size of lesion.

Case 28. Figure 11—Crater and adjacent loose body. Figure 12—Appearance after drilling, replacement and introduction of nail. The loose body is slightly depressed in relation to the surroundings.
Case 28—Post-operative radiograph which shows groove in nail to facilitate extraction.

Fig. 13

Fig. 14
Case 28—Antero-posterior and lateral views six weeks after removal of the nail. Radiographic healing is complete, but a slight depression can be seen in the contour of the condyle.

Fig. 15
3. No lesion is visible on the articular cartilage; or the site is indicated by a shallow groove or depression. This is the type of case to which simple drilling can be applied. The first step is accurate localisation of the lesion. To this end inspection, related to the radiographic findings, may be all that is necessary. Sometimes, although the cartilage is intact, a search in the intercondyolar notch above the rolled edge of the articular surface will reveal tags of fibrous tissue protruding from a fissure which leads into the horizontal cleavage. The actual fissure cannot be seen but the point of a button-hook retractor can be inserted into it. If no indication of the site of the lesion exists, or if the indications are indefinite, radiographs with markers of Kirschner wire in position should be secured to avoid the possibility of error (Fig. 21).

Fig. 14—Extensive radiological lesion.

A point is selected at about the centre of the bony element and a small stab wound inflicted on the articular cartilage through which the "drilling" is performed. Originally a fine diamond-pointed drill was used, but experience has shown that perforation of the area in every possible direction consistent with the use of a small common point of entry is accomplished most easily with a fine sharp-pointed instrument such as a length of Kirschner wire driven directly inwards by hand (Figs. 16 to 20).

**AFTER-TREATMENT**

The factor that has influenced after-treatment has been the need to secure at least right-angled flexion to gain access to the nail. Initially the joint is treated exactly as if a semilunar cartilage had been removed; but in the third week, instead of permitting a return to weight bearing, mobilisation proceeds until it is clear that full flexion is attainable. Thereafter a plaster excluding the foot is applied in extension and the patient is permitted to get up.
Case 14—The site of the lesion is indicated by a raised area and adjacent depressed zone of darker colour. The articular cartilage is unbroken.

Fig. 18

Case 14—Antero-posterior and lateral views twenty weeks later. Radiographic healing is complete.

Fig. 19  Fig. 20
using a patten and crutches. Quadriceps exercises, in the form of muscle setting, together with straight-leg and loaded-straight-leg raising, are practised at hourly intervals from the fourth day. At the end of twelve to sixteen weeks, depending on the estimate of healing time, the plaster is removed, radiographs are taken and remobilising exercises are begun.

Removal of the nail—If internal fixation with a nail has been used the nail is removed when the requisite degree of mobility has been attained by active means. The forcible flexion of a stiff joint under anaesthesia is likely to provoke undesirable reaction and delay recovery. In this respect, if, at the original operation, a torn semilunar cartilage is found underlying a lesion which warrants the use of internal fixation, it is desirable to defer the excision of the cartilage until the second operation when the nail is removed in order that the normal after-treatment of a cartilage operation can be pursued.

The scar of the original incision is excised. The access required is minimal and should not necessitate division of the anterior and antero-central attachments of the cartilage. The nail is extracted by removing a small piece of articular cartilage from the nearest side with a very small gouge and then hooking the gouge point into the groove on the neck of the nail.

The further treatment, and especially the decision as to when to permit weight bearing, depends on the assessment of the degree of healing determined by radiographs and the visual evidence at operation in relation to the degree of recovery of the quadriceps.

OTHER JOINTS

The ability to treat osteochondritis dissecans by the operative methods described is determined by the size of the fragment, and especially of the bony element, in relation to the size of the joint. In the elbow, for example, the nature of the lesion is such as to make the present methods inapplicable. The condition is, however, more important in terms of loss of function in the weight-bearing joints. Two attempts have been made, therefore, to treat lesions in the talus by drilling. It is emphasised that these are the only cases so treated; that the approach is of necessity relatively destructive; and whether the end-result justified the means is almost impossible to assess, except in so far as no other method of treatment was available in the circumstances except arthrodesis.

In the first patient, a woman aged thirty, the lesion was located by tomographs on the postero-medial aspect. Direct access was possible only by a medial trans-malleolar approach. In order to effect absolute accuracy of replacement, a screw was inserted through to the malleolus into the tibia and then partly withdrawn before the bone was divided with a fine osteotome at the point where the vertical and horizontal portions of the articular surface meet. The fragment was retracted downwards to give good access for the drilling of a lesion in which the articular cartilage was unfractured. The operation was completed by replacing the malleolus and driving home the screw. After operation the part was immobilised in a plaster for four months, in the first two of which a patten and crutches were used, and in the
second weight bearing was permitted. The lesion at this time appeared to have healed radiologically. After three further months of exercises the patient declared herself symptomless except that the ankle tired more readily.

In the second patient, a man aged twenty-one, the lesion was located by tomographs on the postero-lateral aspect. Direct access was possible only by a lateral trans-malleolar approach. A straight incision was made over the fibula slightly anterior to its most prominent aspect. A small opening was made in the capsule immediately anterior to the fibula in order to locate the level of articular surface of the tibia. A long, oblique incision from before backwards and upwards, beginning at the joint line, was then made in the periostium of the fibula. A horizontal hole was drilled at the mid-point of this incision and a self-tapping screw inserted. The screw was then withdrawn and an oblique osteotomy, in direction from before backwards and upwards and inclining posteriorly, was made with a fine saw. The malleolus, together with the peroneal tendons, was retracted backwards. The fragment, which was larger than expected, was loose, at least on its lateral aspect; the extent of the medial margin could not be seen. Drilling of the crater was accomplished through the lateral fissure with a Kirschner wire.

When the lateral malleolus was replaced and the foot dorsiflexed, the fragment remained in reasonable apposition to the parent bone. Internal fixation would have been desirable if recovery of the nail had been possible without detriment to the joint. The incision was closed by reintroducing the transverse screw and suturing the periostium.

At the end of operation a pressure bandage and plaster were applied. When the sutures were removed a skin-tight plaster was substituted and the patient permitted to get about for the next three months using a patten and crutches. In the fourth month weight bearing was permitted in the plaster.

RESULTS OF TREATMENT

No claim is made to have solved the problem of the treatment of osteochondritis dissecans; far from it. It is not possible to assess results in a condition that in the natural course of events produces traumatic osteoarthritis in greater or lesser degree in a greater or lesser period of time, depending on such a variety of factors. It is claimed, however, in the cases recorded (with the exception of Cases 21, 22, 30, 31, 32) to have eliminated the symptoms for which the patient originally reported, namely, pain, instability and recurrent effusions; to have produced radiographs in which the lesion appears to have healed; and to have produced visual evidence, in the seven cases in which exploration to remove the means of internal fixation was necessary, of restoration of the articular surface, even after a loose body had separated.

POSSIBLE DEVELOPMENTS

The greatest difficulty that has been encountered has been the accurate replacement of the fragment, which tends to sink below the level of the surrounding articular surface as a result of loss of bone from the base of the crater. This can be only partly overcome in the preparation of the bed by the raising of some bone to a higher level (Smillie 1951). Consideration has therefore been given to the possibility of adding autogenous or homogenous cancellous tissue. This matter has not been pursued so far. It was felt that to complicate a procedure under trial with an additional manoeuvre of unknown effect was unjustifiable. Homogenous grafts—No solution has been offered in the case untreatable by the methods described. Such circumstances, and those referred to above, prompt the suggestion that the affected area be excised by trephine and replaced by frozen homograft of articular cartilage and bone of suitable surface contour. This idea, too, has not been pursued in the absence of reliable information regarding the reaction of articular cartilage to freezing. It is of interest, however, that Ehalt (1955) has reported the results of experiments showing that the viability of frozen cartilage cells is not lost for four or five weeks. He records the replacement by
massive bone and cartilage graft of a tuberculous focus in the lower femoral epiphysis of a boy aged five; and of the articular surface of the patella for chondromalacia in a woman aged twenty-seven. The possible application to osteochondritis dissecans was mentioned. If the experiments are confirmed it is evident from the experience of this series that the transference of banked cartilage and bone to a defect in the femoral condyle presents no serious technical difficulties. To attain perfection, whole right and left condyles from youthful subjects would probably be required and, according to Ehalt, discarded at intervals of six weeks. If the practical difficulties of securing, preparing, storing, and constantly replacing such material can be overcome, a spectacular advance in the treatment of many more conditions than osteochondritis dissecans will be possible.

SUMMARY

1. The record is presented of an attempt to treat osteochondritis dissecans on idealistic lines.
2. The operative technique to be adopted in the various circumstances likely to be encountered in the knee joint is described. Two cases affecting the talus are recorded.
3. The radiological appearance has become virtually normal in twenty-seven cases (the remaining four are recent); healing has been observed directly in seven cases in which a second operation to remove the means of internal fixation was necessary; and the patients' complaints have been eliminated, but the long term results of treatment are unknown.
4. Suggestions are made for possible developments in the technique of operation.

I acknowledge with gratitude the help of my colleagues of the Eastern Region (Scotland) Orthopaedic Service: Mr J. Hutchison, Mr I. D. Sutherland, Mr G. Murdoch, Mr R. D. Muckart, Mr G. L. Clark and Mr C. S. Campbell, who, by referring their cases to me, have made possible the accumulation of the material; and of Mr Peter Fraser, Chief Technician of the Orthopaedic Workshop of Bridge of Earn Hospital, Perthshire, who was responsible for the development of the instruments and the nails.

REFERENCES