POST-TRAUMATIC EROSIONS OF ARTICULAR CARTILAGE

H. V. CROCK, MELBOURNE, AUSTRALIA

From St Vincent's Hospital, Melbourne

Erosions of articular cartilage are often seen in the knee joint in association with certain internal derangements such as meniscus tears or after recurrent subluxation of the patella (Helfet 1959, Smillie 1962). Also a number of studies have appeared on the pathology of articular cartilage after injury, both in man (Landells 1957) and in experimental animals (Barnett 1956, Tallqvist 1962, Meachim 1963). However, attention does not appear to have been directed towards the clinical diagnosis and management of isolated articular cartilage erosions after injury, with the exception of several papers bearing on the patella (Büdinger 1908; Wiles, Andrews and Devas 1956).

The present paper deals with sixteen patients with articular cartilage injuries in various joints (Table I). These lesions predispose to osteoarthritis in the affected joints, although the

TABLE I
JOINTS AFFECTED BY ARTICULAR CARTILAGE EROSIONS

Joint involved	Number of patients
Hip . . .	1
Knee . . .	11
Elbow . . .	1
Wrist . . .	3

evolution of this process may be measured in years. Meanwhile, a number of disabling symptoms and signs, varying with the pathology in individual cases, can be attributed to the cartilage erosions (Figs. 1, 2, 5 and 6).

In this series diagnosis was confirmed at operation in every patient. Although the treatment is described the real purpose of the paper is to draw more attention to a condition which is neglected clinically.

Clinical features—A specific history of injury was obtained from each patient. Shearing stresses or direct compression forces of short duration seemed to be the cause of the lesions. For example, one patient injured the articular cartilage of the carpal scaphoid bone by wrenching her wrist when she grasped a bannister to save herself while falling downstairs. Another developed symptoms in his right knee after jarring his leg while digging in heavy clay. A third developed pain and recurrent swelling in the left knee after striking the lateral aspect of the femoral condyle against the sharp edge of a desk.

The value of knowing the direction and nature of the force producing fractures has been described by Perkins (1956). In the present context this knowledge is also of great importance provided that the clinician appreciates that the force may have damaged the articular cartilage. This aspect of an injury to a joint is rarely considered in the surgical teaching of students, especially when the injury has not caused bony damage.

The main symptoms were found to be pain, joint swelling, and transient and intermittent crepitus with stiffness or instability of weight-bearing joints (Table II). Usually the pain was not severe, but had a dull, persistent aching character. In the lower limb standing aggravated the pain, as did movement or lifting in the upper limb.

FIG. 1

FIG. 2

Case 2. Figure 1—The medial femoral condyle of the right knee joint at operation showing the articular cartilage erosion near the outer border of the condyle. The cruciate ligaments and medial meniscus were normal. Figure 2—The multiple nodular cartilaginous loose bodies which had come from the articular cartilage lesion on the medial femoral condyle, shown through a lateral incision. Synovial crepitus had been a constant sign on clinical examination of this joint over many months.

FIG. 3

FIG. 4

Figure 3—Case 2. A lateral radiograph of the right knee joint showed the localised subarticular osteoporosis at the femoral condyle. Figure 4—Case 3. An antero-posterior radiograph of the right knee joint. There was an extensive area of damage to the articular cartilage of the lateral tibial plateau, and the localised subarticular osteoporosis was confined to this part.

TABLE II
CLINICAL FEATURES

Case number	Age (years)	Sex	Occupation	Joint involved and nature of injury	Symptoms and signs	Diagnosis before operation	Interval between date of presentation and operation
1	24	Male	Clerk	Right knee injured at football three years before	Recurrent throbbing, swelling and giving way of the knee, followed by locking. Moderate effusion	Lateral meniscus tear	One month
2	35	Male	Public servant	Right knee jarred while digging in heavy soil	Pain from the time of injury with persistent aching and recurrent effusions. Synovial crepitus over the synovial membrane with knee flexion	1) Post-traumatic synovitis 2) Post - traumatic articular cartilage erosion of medial femoral condyle recognised at the first operation	1) Six months 2) Seven months
3	37	Male	Meat boner	Right knee struck on lateral side and twisted in a motor accident	Pain on the outer side of the knee. Slight fullness over the antero-lateral aspect of the joint with slightly restricted extension. Severe articular crepitus on rotation in the lateral compartment of the knee	Post-traumatic erosion of the lateral tibial condyle	Eight months
4	29	Male	Butcher	Left femoral shaft fractured ten years before. Pain in the knee since then	Aching and burning pain, with transient stiffness. Severe synovial crepitus	Post-traumatic articular cartilage erosion probably of the medial femoral condyle	Six months
5	38	Male	Labourer	Left elbow twisted at work while carrying heavy steel	Severe pain at the elbow. Tenderness on lateral side with synovial swelling and crepitus. Movements limited. Articular crepitus on rotation of the radius with the elbow flexed to 90 degrees	Post-traumatic articular cartilage erosion with haemarthrosis	Three months
6	17	Female	Typist	Left wrist crushed in a fall at basketball	Continual aching and pain over the dorsum and radial side of the wrist. Palmar flexion limited. Painful click on lateral and medial rotation	Post-traumatic lesion of articular cartilage of the proximal carpal row	One month
7	26	Female	School teacher. Nun	Left knee knocked on lateral side on the corner of a table	Pain over the lateral compartment of the knee present all the time, but worse intermittently. Tenderness over the lateral femoral condyle, and slight tenderness over the pre-patellar area	1) Pre-patellar bursitis 2) Post-traumatic erosion of the articular cartilage of the lateral femoral condyle	1) Two weeks 2) Two months

8	53	Male	Labourer	Right knee jarred when the patient jumped six feet from scaffolding	Pain and swelling with clicking felt in the lateral side. Tenderness over the medial side with a moderate effusion and mild synovial crepitus	Post-traumatic articular cartilage erosion	Three months
9	36	Male	Truck driver	Left wrist injured in a fall on the outstretched hand	Aching and tenderness over the dorsum of the lower end of the left radius. Clicking and articular crepitus	Triangular cartilage injury	Four months
10	18	Female	Typist	Right wrist wrenched by gripping a bannister when falling downstairs	Pain after injury, and clicking developed after three days. Persistent ache in the wrist. Articular crepitus on movement	1) De Quervain's disease 2) Post-traumatic articular cartilage erosion	1) Four months 2) Six months
11	34	Female	Housewife	Right knee sustained a direct blow on the medial femoral condyle in a fall from a bicycle ten months before	Swelling, stiffness and clicking of the knee. Pain at night. Large effusion and severe tenderness on the medial joint line, with synovial crepitus	Post-traumatic erosion of articular cartilage of medial femoral condyle	Three months
12	27	Male	Labourer	Left knee injured in a motor car accident seven months before with an open fracture of the left patella	Swelling and aching of the knee. Mild retropatellar crepitus, but severe synovial crepitus	Post-traumatic erosion of articular cartilage	Three months
13	45	Male	Salesman	Right elbow struck on the lateral side of the edge of a table ten months before	Pain and tenderness over head of radius and a constant aching pain in elbow	Tennis elbow	Eleven months
14	31	Male	Farm labourer	Right knee forcibly flexed on to a metal bar and trapped in this position	Pain, aching and giving way, often unexpectedly. Quadriceps wasting. Full movements with severe articular crepitus	Meniscus remnant following previous meniscectomy. Perhaps associated with articular cartilage erosion	One month
15	46	Male	Salesman	Right knee jarred in fall from chair	Pain and recurrent effusion. Knee gives way unexpectedly. Severe retropatellar articular crepitus	Chondromalacia of patella. Post - traumatic cartilage erosion	Five months
16	34	Male	Salesman	Right hip directly injured when knocked over fourteen years before	Pain on weight bearing with a bad limp only	Severe psychoneurosis. Post-traumatic articular cartilage erosion of acetabulum	Five years

The physical signs varied with the nature, extent and localisation of the articular cartilage erosions. Moderate effusions were seen more commonly in affected knees than in any other joints. The effusion tended to recur or even to persist during the many months of observation before surgery, but after operation it always subsided and did not recur. Crepitus was a valuable sign, occurring in two quite distinct forms. The first, which will be called "articular crepitus," resembled the familiar joint crepitus of osteoarthritis or of chondromalacia. It could be elicited only when the damaged area of cartilage was examined. For example, it may have been found in an affected knee joint while the tibia was being rotated on the femoral condyles with the joint flexed to 95 degrees—but in no other position. The second, which will be called "synovial crepitus," resembled that which can be felt over a tendon sheath in acute tenosynovitis. This was a unique physical sign which was often transient. It was due

FIG. 5

FIG. 6

Figure 5—Case 5. The left elbow, opened from the lateral aspect, to show the articular cartilage erosion on the capitulum. Articular crepitus was produced before operation by rotating the head of the radius on the humerus with the elbow flexed to 90 degrees. Figure 6—Case 12. The right knee joint, opened from the medial side, showing the marginal articular cartilage lesion. Note the ridging of the articular surface of the medial femoral condyle and the ingrowth of pannus. Synovial crepitus had been a prominent physical sign.

either to the movement of fine cartilaginous loose bodies caught between gliding synovial membranes or to the uneven movements of synovial membrane across a ridged area of cartilage covered with pannus (Fig. 6). Some restriction of joint movement was common, especially at the elbow and wrist. However, under anaesthesia the range of movement was normal.

Radiography revealed areas of localised subarticular osteoporosis in a few patients (Figs. 3 and 4). This sign was regarded as a useful aid in diagnosis. The anatomy of the subchondral circulation in adult bones is complex, particularly on the venous side (Crock 1962). It is suggested here that the resorption of metabolites from the damaged area of cartilage may provoke a twofold response: firstly, that this is probably one factor in the production of the reactionary effusion, and secondly, that resorption of these products through the subchondral

capillary bed may provoke a response in the subarticular venous plexus, which leads to this peculiar localisation of the osteoporosis.

It is not possible to offer any suggestion on the frequency of this radiographic finding in patients with articular cartilage erosion after injury. However, these observations are presented in the belief that they may be of significance in helping to establish this diagnosis.

Findings at operation—Joint fluid was usually excessive and contained slimy remnants of minute articular cartilage flakes or multiple small nodular loose bodies (Fig. 2). The synovial membrane and other intra-articular structures such as ligaments or menisci, appeared normal. When the articular cartilage lesions were situated at some distance from the joint margins their appearances varied from nodular swellings to fissured cracks or erosions surrounded by discrete flakes of cartilage with rounded free edges (Figs. 1 and 5).

Wiles *et al.* (1956) described the naked-eye appearances of chondromalacia of the patella as follows: "The nodular area is lustreless and grey or yellow in colour, and it is distinct from the glistening, blue normal cartilage surrounding it." This is an excellent description which applies admirably to some of the lesions in this series. A feature of marginal articular cartilage injuries was the ingrowth of a highly vascular, flat, thin pannus from the adjacent synovial membrane, which sometimes produced localised ridging of the synovial tissues. In these cases the physical sign of "synovial crepitus" had been found before exploration (Fig. 6).

At operation the lesions were dealt with either by shaving of the affected areas of cartilage until smooth surfaces presented or by combining the shaving procedure with closely approximated drill holes penetrating the subchondral bone plates. The diameters of the drills used varied between one millimetre for carpal bones and four millimetres for the femoral condyles.

When articular cartilage erosion occurred in weight-bearing areas, and in which drilling of the subchondral bone plate had been done, weight bearing was not allowed for three months after operation. However, early movement was encouraged irrespective of the method of surgical treatment of the cartilage lesion.

The results of treatment are set out in Table III.

DISCUSSION

Isolated lesions of articular cartilage may be found after injury which has otherwise produced neither damage to the bone nor to the other components of a joint.

For many years the role of injuries in the production of chondromalacia of the patella has been recognised. However, even in this condition, some unknown primary cause of articular cartilage degeneration has usually been implicated—the injury simply aggravating the condition—to produce the characteristic local changes such as fissuring or flaking (Wiles *et al.* 1956). Some of the patients in this series fit into the category of the description by Wiles and his colleagues. However, in others the only demonstrable lesions in the affected joints were localised cartilage erosions, and the adjacent articular cartilage was normal.

There is, therefore, a clear distinction to be drawn between, on the one hand, joints in which a wide area of articular cartilage is softened and frankly abnormal to examination at the time of operation—and in which there also exists some local change of fissuring or flaking—and, on the other hand, those in which all the joint cartilage appears and feels normal, with the exception of a local erosion. In the first instance an injury has aggravated a primary degenerative condition, whereas in the second it has produced a local erosion in otherwise normal cartilage.

The diagnosis of primary post-traumatic articular cartilage erosion is difficult to establish. If the existence of the lesion were to be more generally appreciated, then the diagnosis would be established more often. It is important that this should be so, because it can cause protracted

TABLE III
FINDINGS, TREATMENT AND RESULTS

Case number	Radiographic findings	Findings at operation	Treatment	Result
1	Normal	Moderate effusion with flakes of cartilage floating in the joint from an erosion on the upper anterior segment of the tibial articular cartilage. Menisci normal	Removal of loose bodies. Shaving of the articular cartilage on the lateral tibial condyle	No effusion. Full movements. Symptomless. Last seen four months later
2	Localised sub-articular osteoporosis over lower end of the femoral condyle (Fig. 3)	Multiple loose bodies. Localised area of articular cartilage erosion on the medial femoral condyle (Figs. 1 and 2)	Lateral arthrotomy of the knee. Diagnosis established. Removal of loose bodies. Shaving of articular cartilage and drilling of subchondral bone plate	No effusion. No crepitus. Full extension. Slight loss of full flexion. Last seen sixteen months later
3	Localised sub-articular osteoporosis over the right lateral tibial plateau (Fig. 4).	Extensive articular cartilage erosion over the tibial plateau, and on the posterior half of the lateral femoral condyle	Affected condyles of tibia and femur shaved, and one-millimetre drill holes made	No effusion. No synovial crepitus. No tibio-femoral crepitus in lateral compartment. Movements normal. Last seen seven months later
4	Normal	Large erosion of the medial femoral condyle. Scarred synovial tissues	Shaving of the medial condyles of the tibia and femur	No residual symptoms. Full movement of knee. Last seen fourteen months later
5	Subarticular osteoporosis in lateral view of left capitulum	Localised articular cartilage erosion of capitulum (Fig. 5)	Shaving of eroded area	Symptoms partly relieved. Last seen nine months later
6	Normal	Cracked cartilage on radial surface of the lunate bone	Shaving of proximal articular cartilage of lunate	Symptomless. Full movements. Last seen four months later
7	Normal	Pre-patellar bursitis. Localised articular cartilage erosion on the lateral edge of the lateral femoral condyle. Severe injection of the synovial membrane locally, but no pannus formation	Excision of the pre-patellar bursa Shaving of affected zone of cartilage	Symptoms unchanged after the first operation Improved after the second operation. Last seen four months later
8	Normal	Effusion into the joint with whitish flakes of soft gelatinous material. Two parallel longitudinal splits in the articular cartilage in the intercondylar area of the femur, with soft flaky articular cartilage between them. A similar lesion of the medial articular facet of the patella	Cartilage of the patella and femur shaved and the femoral condyle drilled	Improved. Last seen two months later

TABLE III—*continued*
FINDINGS, TREATMENT AND RESULTS

Case number	Radiographic findings	Findings at operation	Treatment	Result
9	Normal	Fissuring and flaking of lunate cartilage	Lunate cartilage shaved	Improved. Last seen twenty months later
10	Normal	Slight injection of synovial sheath of extensor tendons of thumb, but no convincing abnormality Oval area, six millimetres wide, of softened articular cartilage on radial facet of the scaphoid	Slitting of extensor tendon sheath at base of thumb Shaving of erosion of articular cartilage of scaphoid, and drilling of subchondral bone plate	Symptoms not relieved Improved. Last seen six months later
11	Normal	Erosion of articular cartilage of medial femoral condyle, and chondromalacia of patella	Shaving of articular cartilage and drilling of subarticular bone plate of medial femoral condyle	Greatly improved and felt as though she had a new leg. Last seen three months later
12	Normal	Erosion of articular cartilage of medial femoral condyle. Cartilage softened and covered with pannus. Similar lesion on cartilage of patella (Fig. 6)	Shaving and drilling of articular cartilage of medial femoral condyle, and shaving of patellar articular cartilage	Improving. Last seen three months later
13	Normal	Softening and flaking of the outer rim of the articular cartilage of the head of the radius, with pannus extending upwards towards the radial head plateau	Cartilage shaved. Synovial tag removed from between the head of the radius and the capitulum	Greatly improved. Aching relieved. Last seen two months later
14	Subarticular osteoporosis right medial femoral condyle	Ridging of the articular cartilage of the patella in a vertical plane on the medial side and severe post-traumatic softening of the middle area of the patella. Heaping up of the articular cartilage in the intercondylar area of the femur	Shaving of the cartilage and drilling of the subchondral bone plate of the femur	Greatly improved. Last seen two months later
15	Normal	Severe softening of the patellar cartilage. Fissuring of the medial femoral condylar cartilage	Shaving and drilling of the articular cartilage of the medial femoral condyle, and shaving of the patellar articular cartilage	Improved. Last seen one month later
16	Normal except for tomograms which showed localised subarticular bone plate erosion in weight-bearing area of acetabulum	Posterior arthrotomy and dislocation of the hip. Articular cartilage of the femoral head appeared normal. Localised erosion of the articular cartilage in the weight-bearing area of the acetabular roof	Shaving of the affected area of cartilage. Drilling of the subchondral bone plate. No weight bearing until four months after operation	Mental condition restored to normal. Hip improved. Continued to limp intermittently. Last seen eleven months later

disability after joint injury. Some of the patients in the present series had been disabled for years before the underlying cause was recognised and treated. In the meantime they had been labelled as psychoneurotics. The clinical picture of recurrent effusions, persisting aching pain in the joint together with the signs of crepitus of two distinct varieties, after a specific injury should bring this diagnosis to mind.

Radiography may provide useful confirmatory evidence if the sign of localised subarticular osteoporosis can be demonstrated. Tomography is also sometimes useful. The anatomical basis of the radiographic findings in this condition has been discussed.

In regard to treatment, no authoritative statement can be made at the present time. From the results presented in this series it is clear that shaving of the affected area of articular cartilage may be useful in preventing the shedding of loose bodies into the joint. There is no general agreement on the potentialities of articular cartilage for repair after shaving.

The rationale of drilling the subchondral bone plate has been discussed in the management of osteoarthritis of the knee, but its application to the treatment of articular cartilage erosion appears reasonable (Pridie 1959).

SUMMARY

1. Sixteen patients with articular cartilage erosions after slight injury have been described, as have the results of their treatment.
2. The clinical features of this rarely diagnosed condition are discussed. Attention is drawn to "articular crepitus" and "synovial crepitus" as useful physical signs in establishing the diagnosis.
3. A radiographic sign of localised subarticular osteoporosis is reported and discussed.
4. The surgical treatment used was either shaving of the affected area of cartilage or a combination of shaving with drilling of the subchondral bone plate.

I wish to thank my wife, Dr M. C. Crock, and Miss M. Philipps for their help in preparing this paper. The photographs were produced with great care by Mr A. Daniel and Mr E. Moir, whose assistance I appreciate. I thank also Dr Gordon Donnan and Dr P. H. Cody who offered useful comments on the radiographic findings.

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