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CHONDROMALACIA PATELLAE*

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[WITH PHOTOGRAPHURE PLATE]

Degenerative changes in the knee-joint are common and often begin at an early age. The degeneration affects first and mainly the articular cartilage of the patella, and in young people is an important and common cause of disability.

Incidence

In an admirable thesis Öwre (1936) describes post-mortem examinations of many knee-joints taken from individuals who had died from causes unconnected with the knee-joint. Degenerative changes in the articular cartilage of the patella were very common even in the younger age groups. Thus of 18 cases in the age group under 20 years, 7 (39%) were found to have a degenerative change in the articular cartilage of the patella; of 32 cases in the age group 20-30, 27 (84%), of 26 cases in the age group 30-40, 25 (96%), and every case in the age group over 40, showed a degenerative change.

It appears from these observations that degeneration of the articular cartilage of the patella often begins before growth has ceased and is present in three or four of every five individuals aged between 20 and 30 and in almost every individual over the age of 30.

Öwre's youngest (post-mortem) case was 14 years. Silfverskiöld (1938) at necropsy found mild changes in the articular cartilage of the patella in 25% of subjects between the ages of 15 and 20, and he quotes a case in which chondromalacia patellae was found clinically in a boy aged 13. Bennett, Waine, and Bauer (1942) reported a series of post-mortem examinations which fully confirm Öwre's observations. Clinical experience of chondromalacia patellae has been described by many surgeons.

Clinical References

Büdingner (1906) reported 15 cases. He considered it to be of traumatic origin, and mentions the occurrence in some cases of "mirror" lesions in the femoral articular cartilage. He obtained crepitus on moving the patella passively against the femur, and believed this to be an important diagnostic sign. His treatment was excision of the degenerate cartilage.

Ludloff (1910) reported a case of a girl aged 15 with pain in the knee-joint, wasting of the quadriceps, and patello-femoral crepitus. He scraped the oedematous cartilage away, and the girl was cured.

Läwen (1925) reported 13 cases, which he treated by excision of the cartilage. He thought the lesion was prob-

ably traumatic. He also performed 44 post-mortem examinations, and found degeneration of the patellar cartilage in 26.

Fründ (1926) reported seven cases. Clinically he noted swelling of the knee-joint, painful limitation of movement, transient locking of the joint, and pain on striking the patella with the knee-joint flexed to 90 degrees but not when the knee was extended.

Aleman (1927-8) examined the articular cartilage of the patella in the course of 220 operations on the knee-joint performed for various purposes. In about one-third of these he found a degenerative lesion of the patellar cartilage, and in 20 cases it appeared to be the cause of the disability. He mentions crepitus and pain on kneeling as the main diagnostic signs.

Slowick (1935) reported two cases. The diagnosis was confirmed by operation in one case (the other patient refused operation). There was a history of injury in both cases, and in each of them x-ray examination revealed an erosion of the articular surfaces of the patella. In the case operated upon Slowick shaved off the degenerate cartilage. Six months later the patient had 70 degrees flexion and no pain.

Kulowski (1933) described the condition as a circumscribed primary degeneration of the articular cartilage of the patella, with fibrillation, fissuring, and erosion of the articular surface. Cartilaginous loose bodies sometimes became detached from the patella. He noted the occasional association with other lesions—e.g., tears of the semilunar cartilages. Pain, intermittent synovitis, tenderness over the patella in acute flexion, and crepitations under the patella were mentioned as the clinical features, the radiograph usually being normal. Kulowski treated his cases by curettage or complete excision of the patellar cartilage. He believed that trauma is the immediate cause of the lesion in chondromalacia of the patella, but that there is an underlying constitutional tendency to degeneration of this cartilage.

Karlson (1939) has similar views about the aetiology. Clinically he noted a feeling of stiffness in the knee, pain, especially on kneeling, "jamming" of the knee-joint, irregular jerky movement ("ratchet" movement), and crepitus from the patello-femoral joint. He operated on 36 cases, excising the degenerate areas of cartilage. Of these, 23 recovered subjectively (but their knee-joints would not tolerate strenuous exertion), 10 improved, and 3 were no better.

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Hinricsson (1939) believes that endocrine disturbance or toxæmia may cause the condition. Murstad (1927), Stören (1929), Oberneidmayr (1930), and Heizmach (1937) also refer to the condition.

I have found the condition at operation on 10 occasions, and have often diagnosed it in cases where operation was unnecessary or inadvisable. My youngest patient (operated upon) was 11 years old.

This frequent occurrence of degeneration at an early age is a remarkable phenomenon which cannot be completely explained. Cartilage in all situations is particularly susceptible to injury because, being avascular, it is incapable of repair. The patellar cartilage is especially vulnerable because of its thickness, and it is constantly subjected to trauma by movements of the knee-joint, most of all during active extension, when the quadriceps holds the patella tightly against the femur. Because of its shape the inner facet is, of the two, the more likely to be affected (Wiberg, 1941). It has a slightly convex surface opposed to the convex surface of the internal condyle of the femur. The outer facet fits more accurately, having a concave surface which receives the convex femoral surface.

Morbid Anatomy

The degeneration is progressive. The early changes are oedema, alteration of colour, and striation of the cartilage. The oedema is circumscribed and causes a nodular bumpy appearance of the articular surface (Plate, Fig. 1). It affects only a part of the surface, occurring more often on the inner facet than on the outer. If both facets are affected the changes are usually more pronounced on the inner side. The oedematous area feels soft to the touch, in contrast with the firm consistency of normal articular cartilage. The affected cartilage loses its bluish sheen and becomes lacklustre and faintly yellow. In the oedematous area and also above and below it fine vertical striations occur in cartilage which is otherwise apparently normal.

Ulceration of the cartilage is the next stage. A part of the oedematous area is superficially eroded (Figs. 2, 3, and 4). The floor of the ulcerated zone has a velvety appearance. In time the ulcer becomes deeper, and eventually the entire thickness of the cartilage is destroyed, exposing the subchondral bone.

Proliferation of cartilage may occur either alone or in association with ulceration. Tufts and twigs of degenerate cartilage project above the general level of the articular surface (Figs. 5 and 6).

In some instances a part of the articular cartilage is broken into flat laminae which overlap one another like the tiles on a roof (Fig. 7).

Occasionally a single pedunculated lamina is elevated as a flap from the articular surface (Fig. 8). This had occurred in one of my cases, and at operation the flap could be seen to fold back during extension of the joint from the flexed position. It had obviously been responsible for the momentary locking of the joint which had been described by the patient.

"Mirror" lesions occur on the femoral condyles. As they are produced by friction against the patellar lesions they are more frequent on the internal condyle of the femur. The "mirror" lesions consist of striation and superficial ulceration of the femoral cartilage in a circumscribed area. Frequently the synovial membrane near the edges of the patella is thickened and injected, and the infrapatellar pad of fat is slightly hypertrophied. At first strictly localized, the condition in later life becomes part of a generalized degeneration of the joint—osteoarthritis.

Radiological Examination : Histology

The x-ray film in many cases (perhaps in the majority) shows no abnormality. This is not surprising, as the bone is involved at a very late stage and then only very superficially. However, a close scrutiny of first-class films may show a characteristic abnormality of the articular surface. The film should be taken in such a way as to bring out the soft shadow of the cartilage. The following abnormalities occur: (a) erosion and indentation of the articular margin (Fig. 10); (b) a localized prominence on the articular surface (Fig. 11); and (c) the appearance of a pedunculated flap of cartilage (Fig. 12).

In normal patellar articular cartilage the superficial cells are arranged parallel to the surface; in the central zone they are arranged in a curved and criss-cross manner; in the deeper layers they lie in rows perpendicular to the line of calcification which separates the cartilage from the subjacent bone. In the intercellular substance fibrils are not seen.

At an early stage of the degeneration, when oedema occurs, the cells appear to be further apart, and in the intercellular substance the fibrils become obvious (Fig. 9). Fissures appear in the intercellular substance, and in some areas extensive splitting occurs. Cells may become clumped together, and individual cells appear swollen and vacuolated.

When the bone is exposed by ulceration of the cartilage absorption of the superficial layers leaves marrow spaces open to the surface, and they fill with fibrous tissue. At the margins of the ulcerated area the deeper layers of the cartilage are invaded by blood vessels, which pierce the line of calcification. Proliferating cartilage cells are grouped around these vessels. Cavities and scattered foci of ossification appear in the cartilage.

Clinical Features

It might be expected that these extensive lesions, proved at necropsy to occur so frequently, would be an important cause of disability during life; in fact, if the condition is known and looked for it is often found. It is a fairly common cause of derangement of the knee-joint.

The degeneration frequently produces no symptoms until gross destruction of the cartilage has occurred, or until imperfect recovery from an injury brings it to light. Öwre (1936) has shown that many individuals who suppose their knee-joints to be normal have some clinical signs of chondromalacia patellae and can recall, when questioned in detail, attacks of pain and effusion and momentary locking. When the condition passes from the latent to the active phase it presents itself clinically as a derangement of the knee-joint. The abnormal patella may cause pain, intermittent effusion, tenderness, derangement of motion, and crepitus. Not all these signs are present in every case.

The *pain* is the presenting feature as a rule, and is felt in or under the knee-cap. It is produced by movements which grind the patella against the femur—i.e., by active extension of the joint as in going up stairs and in rising from the sitting position. The *effusion* is usually slight. *Tenderness* is felt mainly at the edges of the patella and at the lower pole, corresponding to the inflamed synovial membrane and hypertrophied fat pads which are noted at operation and in post-mortem specimens. Tenderness of the patella in kneeling may occur. Occasionally tenderness may be elicited by tapping the patella against the lower end of the femur while the knee-joint is semi-flexed.

Flaps or tags of articular cartilage may project sufficiently to impede the smooth motion of the joint. The case illustrated in Fig. 8 is an example. This man

complained that his knee often became "stuck" during the movement of extension. This semi-locking was painful and momentary. At operation it was seen that the flap of articular cartilage sometimes became folded back upon itself during the movement of extension and subsequently unfolded during flexion. Difficulty in disengaging the fold no doubt accounted for the intermittent stiffness of the joint. A "ratchet" type of motion has been described, but this has not occurred in any of my cases.

The *crepitus* occurs particularly during the movement of extension. It may be produced also by rubbing the patella against the femur while the knee-joint is lying relaxed in the extended position. This friction usually causes a pain of the same quality as that of which the patient complains.

Treatment

For the latent case treatment is unnecessary. When disability is produced physiotherapy or a period of immobilization in plaster may alleviate it but surgical treatment is necessary for many cases. Some writers, as mentioned above, advise paring down the abnormal articular cartilage to produce a smooth surface. I prefer total excision of the patella, because it is so obviously impossible to restore properly the smoothness of the articular surface. By shaving off the degenerate cartilage it is possible in some cases to get a surface which is not grossly irregular, but it must be remembered that anything short of perfection in an articular surface subjected to compression is certain to provoke a mechanical arthritis without much delay.

At operation the patella is inspected through a short internal parapatellar incision and removed if the expected lesion is found. The incision may be extended downwards if necessary for exploration of the knee-joint proper. The result of excision of the patella should theoretically be almost perfect. In practice the cases in which I have removed the patella because of chondromalacia have all eventually had very good knee-joints, but in several instances recovery has been long delayed because of persistent weakness of the quadriceps. The weakness amounted practically to paralysis, seemed to be functional, without any organic basis, lasted several weeks, and eventually disappeared very rapidly.

Case Records

Case 1.—A nurse aged 20 complained of pain under the right knee-cap. There was no history of injury, though she remembered having a transient effusion in the knee-joint many years previously. She was a healthy girl in good general condition. There was slight wasting of the right quadriceps, tenderness over the patella, pain on rubbing the patella against the femur, and fine retropatellar crepitus. X-ray films were negative. The pain continued in spite of prolonged physiotherapy. When the knee-joint was explored an extensive oedema of the articular cartilage of the patella, with a central area of ulceration, was discovered. From the small central ulcer a wart-like button of degenerate cartilage projected and a shallow fissure ran upwards and outwards from the ulcerated area (Fig. 5). The articular cartilage of the femur was normal. The patella was excised, and she made a complete recovery.

At a routine follow-up three years later she stated that her left knee had begun to trouble her, and that she had pain under the knee-cap and in the calf. On examination of the left knee the only physical signs were crepitus and pain produced by rubbing the patella passively against the femur. X-ray films were negative. After three months of physiotherapy and rest had been tried unsuccessfully, the patella was excised. It was strikingly similar to that removed from the right knee-joint. The articular cartilage of the femur was normal. She made a rapid and complete recovery, and the function of both knees is now perfect.

Case 2.—A girl aged 23 complained that for several weeks her right knee had been painful on the inner side. For several

years she had noticed crepitus under the knee-cap. She had injured this knee seven years previously, when the joint had locked and had to be straightened under anaesthesia. There had been six or seven attacks of momentary locking after this, the last time being about a year before I saw her. These incidents were always accompanied by pain on the inner side of the joint and followed by swelling. She was a healthy girl in good general condition. There was slight wasting of the right quadriceps, but no effusion. Tenderness was present over the centre of the internal lateral ligament, and pain and crepitus were produced by rubbing the patella against the femur. X-ray films were negative.

The clinical picture suggested a tear of the internal cartilage, but at operation that cartilage appeared to be normal. A very extensive lesion, however, could be seen in the patella, so the incision was enlarged upwards and the patella removed. There was extensive oedema of the articular cartilage of the patella. In the upper part of this oedematous area fine superficial vertical fissures were observed. At the centre of the articular surface the cartilage was broken up by deep fissures into overlapping laminae, and in the lower part of the articular surface there was an intricate exfoliation of tufts of degenerate cartilage (Fig. 7). On the outer condyle of the femur there was a small "mirror" lesion, with ulceration of the articular cartilage and a few protuberant tufts of cartilage, which were pared off. This patient made a complete recovery.

Case 3.—This patient was a girl aged 19. Five years previously her left knee had given way while she was doing a backward bend during physical training. She was away from school on this account for two weeks, and wore "elastoplast" strapping on the knee for several months. Three months after this injury she fell off her bicycle and bruised the knee. Since these injuries it had been almost constantly painful, and there was occasionally a little swelling after exercise. Physiotherapy and bandaging had produced no improvement. She was a healthy girl in good general condition. There was slight wasting of the left quadriceps, slight painful limitation of flexion and extension of the knee-joint, and pain and crepitus on rubbing the patella against the femur. On x-ray examination there appeared in the lateral view a faint shadow indicating an irregularity of the articular cartilage of the patella.

At operation an extensive lesion of the articular cartilage of the patella was discovered. In the lower part of the medial facet there was a shallow quadrilateral ulcer with a soft velvety floor. The lateral facet was oedematous, and its surface scored by superficial fissures irregularly disposed. At the lower edge of the patella the articular cartilage was heaped up to form an irregular rim. The patella was excised. Her pain was completely relieved, but a feeling of insecurity in the knee persisted for nearly a year. The muscles recovered perfectly, but she was unable to run because she felt that the knee would let her down. This neurosis disappeared eventually. When seen five years after the operation she had made a complete recovery and the knee-joint was perfectly satisfactory.

Case 4.—A soldier aged 31 complained of chronic pain "behind the right knee-cap." The pain had been present for four years. There was no history of injury, no locking, and no instability. The right quadriceps was slightly deficient. There was tenderness over the patella. No other clinical signs were present, but in the lateral x-ray film a slight irregularity suggested an erosion of the articular surface of the patella (Fig. 10).

At operation a gross lesion of the articular surface of the patella was discovered. Running transversely across the lateral facet there was a shallow ulcer 6 mm. wide, with a rough floor, and in the lower part of the articular surface there were two similar but smaller ulcers (Fig. 4). The remainder of the articular surface was unevenly oedematous, and on the upper part there were numerous fine vertical superficial fissures. The patella was excised, and he made a complete recovery.

Case 5.—This patient was a soldier aged 28. Two weeks previously his right knee, formerly apparently normal, had become painful and swollen. The swelling persisted. There was no history of injury. The right quadriceps was slightly deficient. There was a moderate effusion but no tenderness. The range of movement was from 5 to 90 degrees. X-ray films showed a localized irregularity of the articular surface of the patella with some subchondral rarefaction.

At operation an extensive lesion of the articular cartilage of the patella was disclosed. The whole of the articular surface, except a narrow strip along the lower border, was oedematous and covered with fine superficial fissures. The oedema was most pronounced over the medial facet. On the ridge between the middle and lateral facets a deep fissure had undercut a flap of cartilage about 1 cm. square. This flap was pedunculated, being attached by its outer margin. Underneath it the bone was exposed. The synovial membrane around the patella was congested. There was a "mirror" lesion in the intercondylar surface of the femur, with softening of the cartilage and fine vertical fissuring. The patella was excised. The patient made a complete recovery.

Case 6.—A woman aged 20 had pain in her right knee-joint for six months. The pain was "under the knee-cap." The joint swelled at times. There was retropatellar crepitus, and rubbing the patella against the femur caused pain. X-ray films showed no abnormality. Prolonged physiotherapy had given no relief. The patella was removed. There was extensive shallow ulceration of the articular cartilage on the external facet, with fine vertical striations caused by superficial fissures. On the ridge between the facets there was a deep cleft in the cartilage, from which some rod-like pieces of degenerate cartilage projected above the level of the articular surface (Fig. 6). After operation the quadriceps muscle recovered only slowly. It was six months before she had regained the full power of extension. One year later the knee-joint was painless and entirely satisfactory.

Case 7.—A woman aged 22 had for 15 months had pain under the left knee-cap, especially on going up or down stairs and on getting up after sitting for some hours—e.g., in the cinema. The knee swelled occasionally. Passive movements of the patella across the femur caused pain and elicited a fine crepitus. X-ray films were negative. At operation fairly advanced changes were found in the articular cartilage of the patella. There was oedema of both facets, with many superficial fissures in the articular cartilage. On the lower part of the internal facet a small ulcer extended through the whole thickness of the cartilage, exposing the subchondral bone. On the central ridge there were several small rounded excrescences caused by localized proliferation of the cartilage (Fig. 3). The patella was removed. After operation she had great difficulty in regaining control over her quadriceps. For several weeks the muscle appeared to be completely inhibited. It gradually recovered, but the knee became very stiff and was eventually mobilized by repeated manipulations. One year after operation she had a full range of movement, normal power of extension, and no pain.

Case 8.—A woman aged 31 complained of persistent pain on the inner side of the knee and under the knee-cap after an operation for removal of the internal semilunar cartilage, which was said to have been badly torn. There was retropatellar crepitus and pain on passive movements of the patella. An exploratory operation was performed. The internal semilunar cartilage was absent—no regeneration had occurred. The patella showed an early stage of degeneration of the articular cartilage. Over most of the articular surface there was a slight oedema associated with a change in the colour from the normal bluish sheen to a lacklustre yellowish white. Superficial fissures produced fine vertical striations. In places very superficial erosion had occurred, and here the texture of the surface was like that of velvet. The patella was removed. This is a recent case. The patient is making a satisfactory recovery.

Case 9.—A boy aged 11 injured his right knee. The patellar ligament was avulsed from the patella, pulling off a small flake of bone from the lower pole. At operation for repair of this injury an early chondromalacia of the articular cartilage of the patella was observed, with oedema, change of colour, and vertical striations. The patella was left *in situ* as there was no evidence that it had previously caused any disability. He will be kept under observation.

Summary

Degenerative changes in the articular cartilage of the patella often occur and are a common cause of derangement of the knee-joint in young persons.

The patellar lesion is a degeneration of articular cartilage in a circumscribed area, where oedema, fibrillation, and ulceration occur.

The condition may be latent or may cause pain, effusion, derangement of motion, and crepitus. The differential diagnosis from lesions of the semilunar cartilages may be difficult.

X-ray changes are absent or very slight.

Excision of the patella may be necessary.

A small number of cases are described.

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VITAMIN D IN TREATMENT OF CUTANEOUS TUBERCULOSIS*

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[WITH PHOTOGRAPHIC PLATE]

In England experience in the use of heavy doses of calciferol—vitamin D₂—in the treatment of lupus began in August, 1943, with the observation of Dowling on a severe case in which general light treatment combined with Finsen therapy for a number of years had failed. Within three months this patient had improved dramatically. Thereafter Dowling and Prosser Thomas, working in the same department, applied the remedy to every case of lupus that could be mustered. The number was not large, but the results after 2½ years appeared to be striking enough to carry conviction. Accordingly 11 of these cases were presented at meetings of the Section of Dermatology of the Royal Society of Medicine in November and December, 1945. From French literature which became available shortly afterwards it was learned that calciferol had been used on a considerable scale in France following the publication in December, 1943, of M. J. Charpy's original observations which were begun in 1940. Indeed, compared with the mass of observations published in that country, ours amounted to no more than a drop in the ocean.

Dowling and Prosser Thomas's cases were treated almost entirely with calciferol in the form of dry tablets, each

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CHONDROMALACIA PATELLAE : CHARLES GRAY

FIG. 1.—Widespread oedema of articular cartilage producing nodular appearance. Small central ulcer with protruberant degenerate cartilage.

FIG. 2.—Widespread oedema, extensive ulceration, and some projecting tags of degenerate cartilage.

FIG. 3.—Oedema, striation, and some projecting nodules. Shallow ulcer in lower part of external facet.

FIG. 4.—Extensive shallow ulceration.

FIG. 5.—Widespread oedema, change of colour, central ulcer, cartilage tags.

A

B

FIG. 6.—A. Oedema and striation ; prominent tags of degenerate cartilage. B. Deep cleft in articular cartilage of internal facet.

FIG. 7.—Widespread ulceration, numerous deep clefts splitting the cartilage into overlapping laminae.

FIG. 8.—Striation and superficial ulceration. A pedunculated lamina of cartilage elevated in the form of a flap.

FIG. 9.—Section showing oedema and fibrillation of articular cartilage.

FIG. 10.—Erosion and indentation of articular cartilage.

FIG. 11.—Localized prominence of articular cartilage.

FIG. 12.—Showing an elevated flap of articular cartilage.