13. MYOSITIS OSSIFICANS PROGRESSIVA

Synonyms—Fibrositis Ossificans Progressiva

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This congenital affection is characterised by the formation of columns of bone in the soft tissues with progressive limitation of movement. It is usually associated with microdactyly. According to Vastine et al. (1948), it was von Dusch who named the condition myositis ossificans progressiva in 1868, though cases had been described many years before. This title is unfortunate because the primary change is in the connective tissues, fasciae and tendons, the muscle fibres being affected only secondarily; and moreover the changes are not of an inflammatory type. The condition was reviewed by Rosenstirn (1918) who collected 120 cases from the literature; in a few of these he rightly questioned the diagnosis, and he suggested that "fibro-cellulitis ossificans progressiva" was a more accurate title. The subject was reviewed by Nutt in 1923 and he added fourteen more cases from the literature together with one of his own. It was also reviewed by Mair in 1932. Other titles that have been suggested are "fibrositis ossificans progressiva" (Greig 1931) and "hyperplasia fascialis ossificans progressiva" (Goto 1912, reported by Rosenstirn).

Hereditary and familial influences—There is little evidence of hereditary or familial influence. Sympsom (1886) reported a father and son with digital deformity but only the son developed myositis. Drago (1919) reported a patient whose mother had microdactyly. Burton-Fanning (1901) published the case of a father and son, both of whom had myositis ossificans. Gaster (1905) reported the affection in a grandfather, father and three sons—five cases in three generations. It has also occurred in twins, both of whom developed myositis (Vastine et al. 1948).

Sex—Both sexes are affected, males more often than females in the proportion of approximately three to two.

Age—It is obvious that microdactyly arises in foetal life, but the other manifestations usually develop in childhood before the age of ten years. In about 16 per cent. of cases the early signs were noted in the first year of life; and, in some, striking changes in the muscles have been observed so soon after birth that they must have begun in foetal life (Hutchinson 1880, Rosenstirn 1918, Mair 1932). Only occasionally is the onset delayed until adolescence. Mair (1932) found only two records of cases in which the first symptoms appeared after the age of twenty years (Frejka 1929, Hirsch and Löw-Beer 1929).

Etiology—Maldevelopment of the great toe must begin in early foetal life, and the fault that is responsible for changes in the muscles, no matter how long their onset may be delayed, is also congenital. The cause of this mesodermal fault is unknown. No error in calcium metabolism has been proved. It has been suggested that the underlying cause may be similar to that which is responsible for local ossification after injury, the difference between the two conditions being only one of degree (Painter 1921); but study of the two types of case provides little support for this suggestion. The disorder has been reported in dogs and, in at least one instance, it was associated with microdactyly (Rosenstirn 1918).

Clinical signs—Severe crippling may supervene within a few years or it may be delayed for three or four decades. In a typical case localised swellings appear during infancy and childhood, usually in the region of the head or neck and, sooner or later, in the trunk. The swellings may be painful but quite often they are painless and not tender. As a rule they are small, lasting only a few days or weeks, then subsiding or even disappearing altogether, only to be succeeded by others. Injury may sometimes determine the site of a lesion and start the whole
process, but as a rule injury plays no part at all. Garrod (1907) studied a child during the second year of life and described two types of swelling: 1) swellings attached to the deep fascia, covered with normal and mobile skin, firm, elastic and not tender, with thin processes extending from some of them; 2) diffuse, ill-defined thickening of the soft parts with adherent skin, sometimes with local oedema, seen mostly in the lumbar and sacral regions. A swelling that occurred in the neck caused oedema of the arm and dilatation of the veins; in less than three weeks it had almost disappeared and the head then moved freely. A lump might divide into two, each part being joined by diffuse swelling; and one lump was seen to divide on two separate occasions. In studying a boy aged four years, Mair (1932) found that the swellings might be hard from the beginning and thereafter persist, or they might be cyst-like, fluctuant, and blue-red in colour. Swellings of the fluctuant type sometimes resolved into firmer lumps or they disappeared altogether; apparently these were haematoma. A lump has been known to break down and discharge. They vary in size. In a child aged eighteen months a swelling as large as an apple appeared in the neck and disappeared within two months (Westman 1924). In another case there was a swelling the size of an egg which also disappeared. One patient, when four years of age, was said to have the appearance of being "contused all over" (Hamada 1936).

The swellings often cause stiffness and inconvenience, if not actual discomfort; their development may be associated with slight fever even when occurring several months or years after the onset of the disease. Usually the overlying skin is not congested. Even in the early stages there is limitation of movement of the head and neck, often with wry-neck deformity, or limited movement of one or both arms. If a lump subsides or disappears, freedom of movement may be restored. The masseter is affected in about one-fifth of the cases. Almost invariably the dorsal aspect of the trunk is involved and there may be involvement of the proximal parts of the limbs, particularly the upper limbs. Limitation of movement or complete fixation of the elbow by bone block is not unusual but there is seldom involvement of the limbs distal to the elbows or knees. Lumps have been reported over the sternum.

Sooner or later columns, irregular masses or plates of bone appear in the soft tissues. If a lump does not disappear completely bone may be expected to make its appearance within a period of from two to eight months. These bony columns seem to lie in the course of a muscle—for example, in the sternomastoid or in the latissimus dorsi or erector spinae; but bone may also be laid down in tendons, fasciae and ligaments. Sometimes bone is found in unexpected places where it is difficult to decide the tissue in which it has formed: for instance, there is sometimes a bar of bone passing almost horizontally outwards from a mass in the back of the trunk to be attached to the humerus near the insertion of the deltoid, far below the normal position of any muscle inserted into the humeral shaft. The column may be attached to a skeletal bone at one or both ends; or it may be entirely free. On the back, nodular columns of bone often stand out boldly, not uncommonly forming a V, with or without a third vertical column in the midline; and in such cases the latissimus dorsi and erector spinae muscles are believed to be the sites of the bone formation. The deltoid, biceps, brachialis anticus and adductor magnus may be involved, but with much less frequency. The sternohyoid, genio-hyoid and sterno-thyroid muscles have sometimes been affected. The skin has been known to ulcerate over a projecting mass of bone, as for example in the region of the tuber ischii. Ossification of a tendon near its attachment may produce a form of "exostosis." In the forearm and leg the interosseous membrane may be involved.

Certain muscles seem to be exempt, namely the muscles of the eye, face, tongue, diaphragm, heart, larynx, perineum and the sphincters (Mackinnon 1924, Grant 1919). Bone formation has seldom occurred in the skin or in the abdominal wall (Rosenstirn 1918).

Sooner or later the spine becomes stiff with or without kyphosis or scoliosis. The whole spine, including the occipito-atlantal joint, may be completely rigid. The costo-vertebral
joints are stiffened and the chest becomes immobile. As a rule the patient is thin and wasted, and in the worst cases he is bedridden. Involvement of the masseter may interfere seriously with feeding and it may even be impossible to open the mouth. The masseter was involved at the early age of three weeks in a child who survived only six months (King 1854). The temporal and frontalis muscles have been affected (Morian 1899). Resistance to general infections is lowered and intercurrent disease is common. Nevertheless some patients have lived to an advanced age.

In the Hunterian collection of the Royal College of Surgeons of England there is the skeleton of a man of thirty-nine years, a full report of which has been studied by courtesy of Dr L. W. Proger. This specimen shows clearly that bone formation is not confined to the muscles nor even to their immediate vicinity (Fig. 11). In the skull many small outgrowths of bone are seen at various sites, including the supra-orbital ridge and the alveolar process of the superior maxilla; there is extensive ankylosis of the lateral articulations of the spine and most of the costo-vertebral joints; some neural arches are fused and, at certain levels, the supraspinous ligaments are ossified. Attached to the back of the left ilium is a perforated shell of bone which bulges outwards as if it had been formed in the subcutaneous tissue of the buttock—certainly not in the gluteus maximus. Passing from the angle of the left scapula to the humerus is a bar of bone which lies so low and so horizontal that it could have no possible connection with the teres major muscle. The carpal and tarsal ligaments are ossified. This skeleton, and two others similarly affected, are described by Stonham (1892).

**Microdactyly** was first recorded by Helferich (1879) and it is of diagnostic importance, particularly in the early stages before heterotopic bone has formed. The great toes are affected in about three-quarters of all cases. Hallux valgus is common and there may be a scar over the metatarsal head. Reduction in length of the thumb is less frequent; it occurs in less than half the cases. Other digits are affected exceptionally. In two cases all the fingers were reduced in length.

**Other changes**—In at least two cases the femoral necks were thickened (Rocher et Mathey-Cornat 1933, Griffith 1949). Mental and sexual development are normal. There may be some degree of infantilism, presumably secondary, but this is exceptional.

**Blood chemistry**—No constant abnormalities have been found. In the few cases in which blood phosphatase has been estimated it was within normal limits.

**Radiographic appearances**—The density of the extra-skeletal bone varies considerably: it may be less dense and less defined than the normal skeleton; or on the other hand it may be more dense, the skeleton as a whole being osteoporotic in consequence of the severely restricted activity. Exostotic projections or subperiosteal thickenings on the shaft of a bone may be seen in addition to columns of bone in the soft tissues. In an advanced case there may be fusion of vertebrae. In one there was such extensive formation of bone in the quadriceps muscle as to suggest that there were two femoral shafts; and in another there was a continuous sheet of bone from the quadriceps to the tibia completely fixing the knee (Mair 1932).

Microdactyly is associated with reduced length of the phalanges of the great toe and only exceptionally with a short metatarsal bone; there is complete or incomplete suppression of the proximal phalanx which may be reduced to a wedge-shaped fragment. It is said that the phalanges are often fused but the evidence of this is not convincing. The first metatarsal may actually be increased in length by fusion of part of the proximal phalanx, thus forming a rounded end to the bone quite unlike the normal head. A similar shaping of the head may also be seen when the bone is shorter than normal. In the thumb, all three bones may be short, or there may be shortening only of the phalanges. In a case reported by Burrows (1933) the metacarpal was short and the epiphysis of the proximal phalanx was wedge-shaped. Spurs on the back of the os calcis or in front of its tuberosities have been reported. The formation of an "exostosis" on the phalanx of a finger has been described in two children (Rolleston 1901, Herringham 1898).
Progress—The condition usually becomes progressively worse, but the rate of progress varies. Intermissions are not uncommon and sometimes there may be arrest for several years. The time elapsing between the onset of the first symptom and final crippling of the patient may vary from less than ten years to as long as forty years. No treatment is known to arrest the progress of the disease although the possibilities of radiotherapy have not perhaps been fully explored. Operative excision of a bony column is very uncertain in its results; it may not improve the mobility of the joint and moreover bone is likely to reform.

Pathology—There seems no doubt that the primary change occurs in the connective tissue and not in the muscle fibres which are affected secondarily. Intercellular haemorrhage is succeeded by proliferation of embryonic tissue, particularly around the vessels and between the muscle fibres, together with the formation of adult connective tissue, cartilage and bone. These changes are accompanied by fatty, waxy and granular degeneration of muscle fibres and proliferation of the sarcolemma cells (Grant 1919). The new bone is metaplastic and does not depend in any way on the osteoblasts in the adjacent skeleton; it may be associated with the formation of cartilage, and the bone may be hard or soft, but microscopic and chemical examinations have revealed no differences from normal bone.

Diagnosis—Before a case has progressed to the formation of bone the diagnosis may be difficult; but the co-existence of microdactyly should settle any doubts. Myositis fibrosa, a very uncommon condition, is no longer universally regarded as a separate affection. It is noteworthy that microdactyly has been found in some cases reported as myositis fibrosa; but those who believe that the two conditions are distinct point out that myositis fibrosa is commoner in girls and in older patients, that it more often occurs in the lower limbs, and that it is accompanied by pain—even severe pain—much more frequently than myositis ossificans. Myositis fibrosa is said to attack the muscles of respiration and the laryngeal muscles and to run a more rapid course, even to a fatal termination (Mair 1932). The muscles have been described as feeling like a sandbag; and the overlying skin may be erysipeloïd in appearance.

In calcinosus universalis, calcareous deposits may occur in the skin and subcutaneous tissues as well as in muscles and fasciae. Radiographically they are seen as granular and fragmentary opacities, distinct from the shadows cast by the bony skeleton. The same is true of the opacities seen when dermatomyositis results in calcification. In calcinosis the deposits may be absorbed; whereas in myositis ossificans progressiva, when bone is once formed it never disappears.

Dermato-myo-sitis affects the extremities and only later the trunk. There may be fever and sweating, and the spleen is enlarged. The diaphragm, intercostal muscles and palate are affected. With intermissions, the course extends over a period of eighteen to twenty-four months, but not longer. Nevertheless the two affections, dermato-myo-sitis and myositis ossificans, do seem to be closely related.

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CASE 1—MYOSITIS OSSIFICANS PROGRESSIVA

(Figs. 1 to 5.) Female, aged seven years. Extra-skeletal ossification first noticed when she was two and a half years old. Had been treated by prolonged recumbency for "glands." One of family of eight: others normal. On admission—mild kyphotic curve; dorsal and lumbar regions of spine completely rigid. Some movement in cervical spine. Erector spinae large and hard. Hard column in left latissimus dorsi; another mass in the right lumbar region. Bridge of bone in right pectoral muscles with bony protuberance fixed to the sternum. Upper limbs normal but thumbs rather short. Suspicious firmness of left calf (with doubtful shadow in radiograph). Reflexes normal. Bilateral equinus. Great toes small and dorsiflexed; first metatarso-phalangeal joints prominent; bilateral hallux valgus. Radiographs showed ectopic bone in the dorso-lumbar region on both sides, in the left cervico-dorsal muscles and in the right pectoral. First metatarsals abnormal: proximal phalanges of great toes absent (possibly fused to metatarsals).

Tendo achillis lengthened on both sides. The opportunity was taken of removing the bar of bone from the right pectoral muscle; the mass consisted of a gelatinous lump containing bone; and this resulted in definite improvement in the mobility of the limb. Report from the mother thirteen years later: "She is still deformed; the shoulders and spine, and the muscles of the right hip are ossified. She can, however, walk quite well and she leads a normal life but cannot stoop to put on her shoes. She suffers no pain and is always cheerful and bright." Although the condition has progressed, extension of the ectopic ossification appears to have been slow.

Fig. 1
Case 1—Photograph shows the swellings and deformity of the back. There is a vertical column of bone to the left of the mid-line in the cervico-dorsal region.
Case 1—Radiograph shows ectopic bone in the left postero-lateral tissues of the neck.

Case 1—Microdactyly. First metatarsals appear to be lengthened by fusion with the proximal phalanges.

Case 1—Histological sections of the mass removed from the right pectoral region. Note in Figure 4 the degenerating muscle fibres (left bottom), newly formed bone and cartilage (right top), and intervening fibrous tissue. Figure 5 shows dense fibrous tissue merging below into cartilage and bone (×24).
CASE 2—MYOSITIS OSSIFICANS PROGRESSIVA

(Figs 6 to 10.) Male, aged sixteen years. No abnormality noticed at birth. At four months a swelling appeared on the scalp; this disappeared completely. At two years a swelling appeared on the front of the neck; aspiration yielded blood only. During the next five years similar swellings appeared in various parts of the back. Sometimes they followed trauma; and they gave the impression of moving from place to place. Some disappeared completely, but others left residual induration and stiffness. The swellings were not painful or tender. By the age of seven years the spine was completely rigid and movements of the arms were limited. Bone was removed from the right latissimus dorsi without benefit. Further swellings appeared but progress was generally slow, except for increasing limitation of movement of the mandible since the age of eleven years. Youngest of family of ten. No other member of family affected with myositis or microdactyly.

On admission spine rigid except for some movement in the cervical and upper dorsal regions. Chest expansion one inch. Bony plaques found at back of neck and in the dorsal and lumbar regions, especially in the latissimus dorsi and trapezius, left maseter, left sternomastoid (fused to clavicle) and right pronator quadratus. Outgrowths of bone from the lesser trochanters and adductor tubercles of the femora (very similar to exostoses in diaphysial aclasis). Plantar fascia involved. Microdactyly of big toes and thumbs. Deformity of great toes similar to that seen in Case 1. Biochemical examinations of blood revealed nothing of importance. (Under the late R. C. Elmslie.)

![Figure 6](image-url)

Fig. 6
Case 2—The hands show microdactyly of the thumbs with deformity of the epiphyses of the proximal phalanges.
Case 2—Figure 7 is a photograph showing the columns and plaques of bone in the back. Radiograph of the dorso-lumbar region shows irregular columns of bone on both sides of the spine (Fig. 8).

Case 2—Lateral radiograph of the cervical spine (Fig. 9) shows a branched column of ectopic bone part of which involves the sternomastoid. In Figure 10 it is seen that there is a small but well-defined calcaneal spur.
CASE 3—MYOSITIS OSSIFICANS PROGRESSIVA

(Fig. 11.) Male, aged thirty-nine years. Details of this patient, whose skeleton is preserved in the Hunterian collection of the Royal College of Surgeons of England, have been given earlier in this text (page 110). This specimen shows that bone formation is not confined to the muscles nor even to their immediate vicinity.