TRAUMATIC MYOSITIS OSSIFICANS RESULTING FROM
GUNSHOT WOUNDS.*

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Traumatic myositis ossificans is a condition in which a single severe trauma, usually without a breach of the skin, and without fracture of bone, is followed by a considerable growth of bone in the contused muscle. This bony new formation is commonly attached to the underlying shaft of the bone that has been contused, but sometimes is found free in the muscle without any such bony attachment.

Many articles dealing with this condition have appeared in recent years. The literature is mainly concerned with (1) The differential diagnosis from periosteal sarcoma; (2) Theories of Etiology; and (3) Methods of Treatment. The differential diagnosis from sarcoma is not dealt with in the present paper, but it has been discussed extensively by Coley.1

My present purpose is, first, to draw attention to the fact that gunshot wounds, and particularly shell wounds, which graze tangentially the smooth shaft of such a bone as the femur, may give rise to a growth of bone in the adjacent muscles precisely similar to the familiar myositis ossificans that follows a subcutaneous trauma; secondly, to point out the value of this fact as evidence of the true nature of the process under consideration.

I will first describe three illustrative cases:

Case 1.—Cpl. W. S. was hit by fragments of a large bomb when on a bombing raid on Nov. 27, 1917. The shell burst some three yards away from him, and wounded him in both thighs, the left leg, and left hand and arm. The C.C.S. notes on the case are as follows: "Operation, Nov. 28, 1917... Wound of left thigh excised. Carrel tubes inserted."

There was no mention of any injury to bone. He was admitted to the 2nd Western General Hospital under my care on Dec. 9.

On admission: On the front of the left thigh, a little below the centre, was an open elliptical wound 4 in. long and 1 in. wide, the result of excision of the wound of entry. The exit wound was on the postero-internal aspect of the thigh at the same level, and had also been excised. There was a slight discharge of pus from both wounds, but no abnormal temperature. On the front of the thigh between the wounds of entry and exit there was a hard swelling extending into the quadriceps muscle and adherent to bone. Flexion of the knee was limited to 10°, and was prevented by the implication of the muscle in the new-formed bone. During March the second wound healed soundly, the bony mass extended a little, and flexion of the knee was still more limited. On April 20 a second radiogram showed typical myositis ossificans (v. Figs. 206 and 207). On account of the extreme limitation of movement it was decided to excise the bony mass, and graft on to the denuded bone a free piece of fascia lata, in the manner described by me in a previous paper.2

Operation, May 5, 1918.—Under ether anaesthesia an elliptical incision was made on the front of the left thigh, surrounding the scar of the larger anterior wound. The scar tissue was excised, and the mass of bone under the quadriceps to the inner side of this exposed. It was found
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to be about 3 in. long and 2 in. broad and raised 1 in. from the femur. It projected from the
front of the femur, to which it was firmly attached, into the crureus muscle. The surface in rela-
tion with the muscle presented numerous blunt knobs and tuberosities of bone, precisely similar
to those met with in ordinary cases of traumatic ossificans.

The whole mass was freed from the surrounding muscle, raised from the anterior surface of
the femur with a gouge, and removed. On the denuded area of the femoral shaft there was now
visible a superficial transverse groove about ½ in. broad, marking the tangential course of the shell
fragment as it had grazed the bone. A quadrilateral piece of ilio-tibial band, 3 in. long by 2 in.
broad, was now excised, and was secured over the bare anterior surface of the femur by a few
interrupted sutures of fine catgut. The muscle was then sutured over the graft and the skin
closed without drainage. At the completion of the operation the knee could be flexed passively
to the full normal extent. The leg was put up on a double-inclined plane, with the knee semi-
flexed.

The result of the operation was somewhat impaired by a slight degree of sepsis, due no
doubt to latent organisms in the scar tissue of the original wound. The scar of exit on the
postero-internal aspect of the thigh re-opened and discharged for a week or so, and there was at
first a good deal of swelling of the thigh. This swelling soon subsided, and both the wounds had
healed at the end of the third week. Active flexion of the knee was limited at first by the
inflammatory swelling, and later by resulting fibrosis, but by June 20 he was walking well and
could flex the knee to 45°. He was invalided out of the army at this date on account of injuries
to his hand. There was no sign of any recurrence of the growth of bone after the operation.

Case 2.—Pte. C. B. was wounded at 2 a.m. on Aug. 17, 1918, by a shell fragment which pene-
trated the left thigh. The shell burst close to him. The C.C.S. notes on his field medical card
were as follows: "Perforating wound thigh, shell fragment. Wound cleaned 7 a.m. Aug. 17.
Compound fracture lower third incomplete. Wounds excised and sutured. B.I.P.P." In spite
of this definite statement as to an incomplete fracture found at operation, a note written at No.
35 General Hospital states, "X ray shows no fracture." We may conclude that the damage to
the bone was superficial. He was admitted to the 2nd Western General Hospital, Manchester,
on Aug. 24, when "a through-and-through wound of soft parts of thigh with no bone or nerve
lesion" was noted. He was transferred to an auxiliary hospital, Sept. 13, with a copious
discharge of pus from the wound. An x-ray report, dated Oct. 5, was as follows: "Faint
shadows, possibly due to B.I.P.P. Slight periostitis of outer surface of femur." A second
radiogram, taken on Dec. 11, shows "very typical myositis ossificans, with extensive new bone
formation" (v. Figs. 208 and 209).

On Dec. 24 he was transferred to another hospital under my care, where I made the following
note of his condition: "There is a recently healed scar on the outer side of left thigh, at the
junction of middle and lower thirds, and a discharging sinus in a scar on the inner side at the
same level. A line joining the two wounds would cross the anterior surface of the femur tangentially. On the front of the femur between the scars of entry and exit is a firm, hard mass adherent to bone and extending into quadriceps. The tumour is obvious on inspection, and is about 4 in. long by 3 in. transversely. Implication of quadriceps in the mass limits flexion to 30°, and attempts flex further cause pain in the bony mass.

On Feb. 10, 1918, the bony mass was still more obvious on palpation. Both wounds had healed, and the degree of flexion was about the same. He walked fairly well, but complained of aching after a long walk. Owing to the comparatively good range of movement and the previous sepsis, any question of operation was postponed. Meanwhile the patient became a defaulter and passed out of my care.

![Fig. 208. Case 2. Jan. 18, 1918. Lateral view.](image)

![Fig. 209. Case 2. Jan. 18, 1918. Antero-posterior View.](image)

**Case 3.**—Cpl. C. N. was wounded on March 21, 1918, by a large shell that burst four or five yards away. A fragment penetrated the left thigh. The first note from the 1st Australian General Hospital states: "X ray shows several tiny foreign bodies in thigh. Wound is apparently through-and-through, but in grazing the bone has left tiny fragments behind. Offensive pus in track. Track excised and cleaned. Two small foreign bodies removed. Wound is posterior to femoral vessels."

He came under my care on Aug. 5, 1918, when the wound of entry on the outer side of left thigh had healed, but the wound of exit on the inner side was still discharging pus. There was an evening temperature of 100° F. at this time. On palpation along the front of the femur between the two wounds an indefinite rounded bony mass could be felt. Flexion of the knee was limited to 15° by adhesion of this mass to quadriceps. An x-ray plate at this time showed a small but typical mass of myositis ossificans extending into the quadriceps from the front of the femur.

The condition slowly improved in the course of the next few months. The wound healed, the range of flexion increased, and the mass decreased in size. Another radiogram taken four months later showed that the mass of bone had been reabsorbed to a great extent, and was now reduced to a small sessile mound of bone on the femur one-fourth of its size in the previous plate. The difference was so striking that Captain Bythell reported: "Deposit of bone on front of femur is not myositis ossificans but periostitis."

These three cases form a sufficiently convincing demonstration of the fact that typical "traumatic myositis ossificans" may be caused by gunshot wounds. They afford, further, interesting confirmation of some experimental work on this condition published in 1910, when I showed, working with rabbits, that intramuscular ossification could be produced in the thigh after open incision and removal of periosteum, provided that the adjacent muscles were severely crushed. It was found that normal, healthy muscles
left in contact with denuded bone immediately assumed the limiting function of the
missing periosteum, and by contracting adhesions to the shaft of the femur prevented
the outgrowth of bone.

In view of this observation it is interesting to note that in each of the present series
the projectile was an irregular shell fragment, and that the close proximity of the bursting
shell to the patient would involve the maximum laceration and contusion of the soft parts.
In searching the literature of the war I have only been able to discover a single paper dealing
with this condition. In a paper read before the Société de Chirurgie on Dec. 6, 1916,
Roche mentions that following tangential lesions of bone by bullets or fragments of shell,
and following contusions or abrasions of the apophyseal protuberances, bony new forma-
tions may develop. Under the influence of traumatism alone, or of traumatism followed
by infection, 'the irritated periosteum' produces new bone in the contused zone. Of his
9 cases, 4 developed in aseptic surroundings and 5 after some suppuration, so that it is
plain that sepsis is not an essential factor.

In my own cases also it cannot be supposed that the factor of sepsis was important
in stimulating the growth of bone. In Case 1, with the most extensive growth, the degree
of sepsis present was very mild as compared with the other two cases. It should be men-
tioned that the Wassermann reaction was positive in Case 1 and negative in Cases 2 and 3,
so that syphilis can hardly be suspected as a causal agent.

Roche includes in his series bony projections from the acromion, trochanters, and
anterior superior spine and crest of ilium; but this type of case, though common enough
and identical in all essentials with the present series, I have intentionally excluded from
this paper, with the object of emphasizing the identity of my cases with the classical
subcutaneous traumatic myositis ossificans.

As regards the nature of the pathological processes underlying this condition, I have
felt bound to reject the theory that metaplastic inflammation of the intramuscular con-
nective tissue converts it into bone, in spite of the arguments in its favour brought forward
by Lapointe and others. In each of my three cases the projectile definitely grazed the
outer compact layer of the femur, cutting a shallow groove in it, and it is surely a simpler
explanation to suppose that the intramuscular ossification was due to an outflowing of
osteoblasts from the Haversian canals of the bleeding bone than to invoke some obscure
'ossifying diathesis' on the part of the connective tissue of the adjacent muscles. I contend
that the process is exactly similar to the outpouring of callus from a completely fractured
bone, and that the greater exuberance of growth in these cases is due to the coincident
trauma to muscle, with loss of its power to limit the wandering

Further, it is probable that the extent of intramuscular bone which ultimately persists
is governed by Wolff's law, in that it owes its survival to the stimulus of the force exerted
on it by the muscle in which it is entangled. I have often been impressed by the fact that
in these relatively common ossifications on the front of the thigh, the quadriceps becomes
inserted into the bony mass, which receives, instead of the tibial tubercle, the chief strain
of its contractions. In those cases, on the other hand, where the new bone goes on to
ultimate reabsorption, it would seem to have been rather submuscular than intramuscular,
and so to have become subjected rather to the restraining lateral pressure of the overlying muscle than to the stimulating influence of its direct traction.

**SUMMARY.**

1. A condition precisely similar to the classical traumatic ‘myositis ossificans’ which follows a severe subcutaneous contusion may result from a gunshot wound that grazes a bone tangentially.

2. The process is essentially the same as callus formation.

3. The exuberant growth of bone is dependent on simultaneous laceration and devitalization of the adjacent muscle, and is ultimately subject to Wolff’s law.

4. In suitable cases, excision of the bony mass, and autogenous grafting of fascia on to the adjacent shaft, is indicated, as restoring movement and preventing recurrence.

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**REFERENCES.**