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ON THE FORMATION OF CALLUS.

*On the Formation of Callus, and the Mode of Remedying it when diseased or deformed.* By BARON DUPUYTREN.

From the "Leçons Orales," published periodically, under the Baron's inspection.

THERE is perhaps no subject in pathological anatomy which has more exercised the sagacity of observers, and the imagination of those who raise up hypotheses without experience, than the theory of the formation of callus. Two opinions have chiefly prevailed in modern times—that of Duhamel, and that of Bordenave. The former attributed to the swelling of the periosteum and medullary membrane, to their prolongation from one fragment to the other, and to their ossification, the consolidation of the fracture. He held that this re-union took place, at one time by means of a simple external ferrule, at another by means of a double ferrule, one enveloping the periphery of the fragment, the other penetrating the medullary canal, where it forms a kind of wedge, of greater or less length.

Bordenave established different principles. He admits that the union and consolidation of broken bone takes place by the same mechanism as the healing of soft parts: led, without doubt, to this idea by what happens when the fractured parts are exposed, he thought he could recognise the existence of cellular and vascular granulations between the fragments. According to him, these granulations united and became solid by the deposition of phosphate of lime in their interior. These doctrines, more or less modified, were received down to our time, when in 1808, having undertaken to verify the ideas of Bordenave and Bichat, I was astonished to find nothing which justified them. I multiplied my researches, and was led by numerous experiments to establish a theory partly founded on that of Duhamel, and which I taught in my course of pathological anatomy. Let us trace the most remarkable phenomena which we observe during the time that a fractured bone is becoming consolidated.

If the parts be examined between the first and tenth days, we find an extravasation of blood round the fragments, between them, and in the medullary canal. The ecchymosis may extend to very distant parts. Inflammation and tumefaction to a considerable extent is developed at the irritated points. The fleshy fibres become confounded with the inflamed cellular tissue, and soon cease to be distinguishable from other parts. The periosteum becomes red and swollen, is softened, and pours out a reddish serous fluid between it and the portions of bone which it covers. The medullary tissue becomes tumefied and inflamed, effacing by

degrees the canal which the centre of the bone presents. The marrow becomes in some measure fleshy, and unites to that of the opposite side. If we examine what is going on with regard to the fragments, we find the clot which separates them to be absorbed in a few days, and replaced by a gelatinous secretion. From the fourth to the sixth day the surfaces of the fracture are covered with a reddish substance, of a downy appearance, but which is not always present. From the tenth to the twenty-fifth day the tumefaction of the soft parts becomes more solid; its adherence to the intermediate substance of the fragments appears every day more intimate; the muscles resume their wonted aspect and functions. The tumor, which I have called *tumeur du cal*, diminishes in extent, and separates from the surrounding parts; the tissue which composes it is homogeneous, like fibro-cartilage, and difficult to divide. If detached, it is found to consist of fibres parallel to the axis of the fractured bone. The swollen medullary membrane is transformed into fibro-cartilage, and progressively narrows the central cavity of the bone, till it finishes by wholly obliterating it.

In proportion as we advance in the examination of the formation of the callus, we observe other particulars: the process may go on to the twenty-fifth, fortieth, or even sixtieth day. In weakly subjects the work is not completed under three months. The lardaceous and fibrous mass which constitutes the "tumor of the callus," and which entirely envelops the fragments, becomes by degrees cartilaginous. Towards the end of the time, the fragments are included in the centre of solid ferrule, which adheres to them through the whole extent of the outer surface. Externally this ferrule is covered by thickened periosteum, which passes into that covering the sound portions of the bone. The cellular tissue in the neighborhood is still in a condensed state. The soft substance which was interposed between, in fragments, has now become more dense and more adherent to the extremities of the bone, but is yet far from uniting them in a perfect manner. The central peg continues to be prolonged towards the extremities, rapidly increases in consistence, and soon forms a very solid cylinder of bone. It is usually at this period that the apparatus is removed, but this callus is not yet to remain; consequently, I have named it the "provisional callus," to point out that nature removes it to establish other means of union between the fragments.

From the third to the fifth, even to the sixth month, the tumor of the callus becomes gradually more compact, and the central portion undergoes the same transformation. The substance between the fragments acquires all the characters and consistence of compact bone, differing only in color. It is the transformation of this substance into bone that I have called the "definitive callus." In the concluding period of the formation of callus, the central portion becomes less dense; cells appear in its interior; it is converted into a reticular tissue, which itself finally disappears, and leaves the central canal of the bone perfectly free. The cells are then lined with a medullary membrane. After the establishment of the canal of the bone, it becomes continuous with the lining membrane which secretes the marrow. The external portion of the provisional callus also finishes by disappearing. It is to be understood that the different circumstances of fractures produce some slight varieties in

those which attend the callus. Thus, when the fractured bones ride, the interior portion or peg is not found, and the same happens when the bone has no medullary cavity.

To recapitulate:—The re-union of bone generally offers the following phenomena : 1. Effusion of blood and viscid fluid. 2. Ecchymosis in the cellular tissue surrounding the extremities of the fracture. 3. The formation of a cartilaginous and bony ferrule externally, and of a kind of peg within. 4. Ossification of the substance interposed between the fragments. 5. Decrease of the tumor of the callus, and restoration of the medullary canal. The term of forty days, mentioned by many, is far from being sufficient ; and where the fracture is oblique, or the bones ride, a much longer time is required.

#### CASE OF ENLARGED TONGUE.

*Abscess and Enlargement of the Tongue, cured by Seton.* By WILLIAM THOMPSON, M.D., Lisburn, Ireland.

A. J., a delicate-looking boy, ætat. one year and seven months, was admitted into the County of Antrim Infirmary, on the 6th of April, 1832, on account of a large abscess in the substance of the tongue.

The disease had been of some months standing, and an opening had been twice made, prior to his admission, in the under surface of the tongue on the right side, which gave exit to a considerable quantity of thin fœtid pus. The reduction in size of the tongue which took place in consequence, nearly allowed of its being replaced in the mouth, from which it had previously protruded to a great extent. On the closure of the opening, which took place a few days after it had been made, the cavity of the abscess became rapidly distended to a greater degree than at first.

The child's appearance on admission into the Infirmary was frightful ; the tongue, enormously enlarged, and protruding from the mouth, was nearly in a state of complete strangulation from the pressure of the teeth ; its surface was dry, covered with a brown fur, and intersected here and there with fissures ; the nostrils were widely distended, respiration being entirely performed through the nose. Food, in a liquid state, could, with difficulty, be administered, by drawing back the angle of the mouth ; the child was, in consequence, very much emaciated.

I immediately made a puncture in the situation of the original opening ; a considerable quantity of matter followed, which gave relief, by diminishing the volume of the tongue. Two days afterwards the *argent. nit.* was introduced into the opening, which was beginning to close. This, however, had not the desired effect ; the matter collected rapidly, and the tongue again protruded. In order to prevent a fresh accumulation of matter, and at the same time to excite inflammation in the cavity of the abscess, I passed a seton through it, by means of a probe which I introduced at the original opening, and caused to project at the opposite side of the tongue. An incision was then made on it, and the seton drawn through. The ends of the cord were then united to prevent its slipping out.