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Publication/Creation

[Place of publication not identified] : [publisher not identified], [1875]

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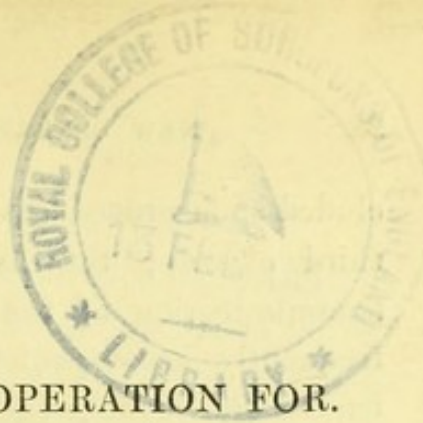
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UNUNITED FRACTURES, NEW OPERATION FOR.

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THE operation to which I devote the following pages I have ventured to call "*new*," but it might with less brevity, but greater accuracy, be described as "a new modification of Dieffenbach's operation." This latter consists in opening up the seat of fracture, and driving ivory pegs into the ends of the bony fragments, with the intention of exciting such an amount of inflammatory action as will result in the throwing-out of reparative material to be afterwards consolidated into *callus*. The theory and practice of this operation has had the sanction of the highest surgical authorities and a large share of success since it was originated in 1845, and still continues to hold its ground, notwithstanding the many other aspirants to surgical favour which have appeared. It may not be out of place here if I make a short *résumé* of the different procedures which from time to time have been recommended and adopted to cause bony union in those troublesome fractures. The number and variety alone of the plans should suffice to prove the intractability of these cases, and the hopelessness of finding any one a panacea for all. As an aid to memory and comparison it may be convenient to divide these remedial measures into three classes, viz.:—*First*, those which do not alter the fracture from its "simple" or unexposed condition. Amongst such are blisters* and other stimulating applications to the skin;† friction of the broken ends of the bones against each other;‡ subcutaneous scarification;§ acupuncture by needles, hot, cold, or galvanic;|| malleting the fracture; compression,¶ &c. In the *second* class may be in-

* Brodie, Walker, Velpeau.

† Malgaigne, Fleury, Buchanan.

‡ Celsus, White, Hunter.

§ C. Bell, Blandin, Miller.

|| Malgaigne, Wiesel, Rrennan.

¶ Amesbury, Bonnet.

cluded such procedures as are transitional between the first and third classes; that is to say, while they cause some slight communication of the fracture with the external air, and are frequently accompanied by suppuration, yet do not absolutely expose the bone; such are the setons,* cauteries actual and potential,† and the metal skewers, screws, or wires which transfix the bone, but project through the flesh.‡ Lastly, in the *third* class must be placed those operations which to all intents and purposes render the fracture “compound,” such as Dieffenbach’s§ and the various plans for resection,|| with or without pinning or wiring the bone-ends together, denuded or not of their periosteum.¶

Any and all of these proceedings require to be aided by some form of apparatus which shall fix and steady the limb, for I need scarcely say it is in the limbs alone our interference is required, if we except some rare cases in the lower jaw. The instrument for firmness and adaptability is best made of iron, much after Liston’s modification of MacIntyre’s; but instead of the extending screw beneath the leg the same object is much better secured by a small endless screw working in a toothed wheel not larger than a halfpenny, which is fixed on one side of the hinge at the knee-joint. The endless screw is finished off with a square or triangular head, and is acted on by a removable key. The apparatus may be connected with the body by a joint at the hip, and a broad abdominal belt as designed by Dr. H. Smith, of New York, thus enabling the patient to get about on crutches if his health suffers from too-prolonged confinement. *A propos* of this it cannot be too strongly insisted on that *there must be no hurry or impatience of result*; it is at all times difficult to draw the line between delayed and ununited fracture, and impatience may convert the one into the other.

I have omitted any mention of amputation, as it cannot be

* Physick, Winslow, Weinhold, Oppenheim, Liston.

† Cline, Earle, Ollenroth, Mayor, Kirkbride.

‡ Bickersteth, Brainard, Sommé, Pancoast, Gross.

§ Dieffenbach, Square, Stanley, Bowman, Bushman.

|| White, Rowlands, Dupuytren, Roux, Gaillard, Rodgers.

¶ Jordan, Sédillot, Bigelow, Horeau.

classed as a cure for these unfortunate cases, although often necessary as a *dernier ressort*. It is an acknowledged principle in surgery that in no case should a severe or major operation be performed where a minor or less-dangerous one promises a fair chance of success. Accordingly, one or more of the measures in Class 1 having been tried and failed, as they often will, then some of those in Class 2 or 3 should be selected, according as they are best suited to the state of the patient and the seat and nature of the fracture. In many instances, especially in the femur and humerus, it is considered "advisable not to employ the seton, but to pass on at once to Dieffenbach's plan,"* as being attended with less danger. Such a case is the one I have now to relate.

Mr. W—, æt. 35, a gentleman of untainted constitution and active habits, had his thigh broken by a railway collision at Wigan on the 25th of December, 1874. He sustained a few other superficial injuries, and was exposed for some hours in the frost and snow. The fracture, which occurred at the junction of the middle with the lower third of the femur, was "simple," and oblique in direction. It was carefully attended by an experienced surgeon at Wigan, who put him up on the long splint, afterwards on a MacIntyre, and finally in plaster-of-Paris bandage. At first all seemed to progress favorably, but at the end of seven or eight weeks he found the fracture still ununited, and requested a consultation upon the patient's case. As I had attended this gentleman before, I was summoned to Wigan, and after carefully examining all the details we made out that Mr. W—'s ununited fracture was mainly to be attributed to a hacking throat-cough (caused by an elongated uvula), which constantly shook his frame and jerked the fragments, more especially the upper. At the same time his bodily condition was soft and flabby from long confinement to bed, so much so that we considered it unadvisable to subject him to any operative procedure just then beyond snipping the elongated uvula and painting the throat with perchloride of iron, which very much checked the cough. As for the limb, a large piece of Cocking's poro-plastic

* Holmes's 'System of Surgery,' vol. ii, p. 93.

felt was moulded into an admirable splint, quite enveloping the thigh, and when tightly strapped enabling him to get about on crutches, and even to bear a little pressure on the foot. After a couple of weeks' hobbling about in this way his health much improved, and he gained sufficient confidence and strength to come down to Liverpool and Bootle, just ten weeks after the accident. The case being now turned over to my care, I had him etherised, and proceeded to break up the false union by forcible twisting and grating of the fractured surfaces against one another. After some weeks I found the result to be simply *nil*.

A consultation was now held with Mr. Reginald Harrison and Mr. Puzey, the latter of whom attended on behalf of the Railway Company, and we agreed to perform subcutaneous scarification of the ends of the bone, and to bend the knee forcibly, as it was getting very stiff; indeed, then and afterwards we found reason to believe that the lower fragment was probably split longitudinally down to or near the articulation, but of this we could not be certain. The limb was then fixed in an improved apparatus of the MacIntyre kind, and left at rest. Again there was no local action set up except some pains in the knee-joint, and at the end of a further five weeks from the time of scarifying the pieces were as obstinately loose as ever. Finding now that something further must be done, and that the most likely would be Dieffenbach's operation, I thought a good deal as to how it might be best performed so as to leave the fracture still in its "simple" state, and finally came to the conclusion that the pegging might be done subcutaneously, thus rendering this severe operation of the third class into the milder one of the first class. The accompanying sketch shows the tools required; they are—an Archimedian drill-stock, a steel drill four or five inches long, and a few ivory stilettes of the same length and diameter (or slightly tapering) as the drill. The drill and stilettes are similarly graduated in half inches, and the ivories are, moreover, grooved like a director in order to slide along the drill. The *modus operandi* consists in entering the drill through a puncture made by a tenotome down to the bone; the depth of the soft parts is

now read off by means of the graduations ; then, if it be desired to bore into the bone to the depth of an inch, the drilling is proceeded with until the steel has penetrated an inch further than the original reading. The ivory stilette is now filed *half way through* an inch from the point (see drawing), and after being soaked in carbolic oil is guided by its groove down alongside the drill to the brink of the perforation in the bone, from out of which the steel is next lifted, the ivory slipped into its place, hammered, and by a smart lateral movement broken off at the filed notch. The operation is completed by withdrawing the remainder of the stilette and sealing the puncture with a bit of lint and plaster. By carefully following the foregoing details it will be found that an inch peg is accurately placed in an inch hole, consequently there is no portion of it projecting into the flesh, and of this we may be certain by seeing before it is broken off that the reading on the ivory at the surface of the skin tallies with the previous reading on the drill, both being graduated alike. A further object is secured by the peg being grooved ; a channel is thereby provided for the escape of fluids in the event of osteomyelitis being set up, thereby avoiding the danger and suffering caused by the damming up in the bone of inflammatory fluids, as would necessarily be the case were the peg solid. If the fracture be oblique or the position of the fragments suitable the drilling may be pushed on into the other portion of the bone, after which a longer peg of ivory can be inserted to hold both pieces together ; this, although difficult, is by no means impossible, and would require some slight modifications in the apparatus. The foregoing plan of the operation was submitted to, and kindly approved by, the gentlemen before mentioned ; indeed, to Mr. Harrison I am indebted for much aid and valuable suggestions in maturing the details, and we tried it together on the dead subject before venturing it upon the living. All being in readiness, the operation was performed, in the manner just described, on the 21st of last May, when we successfully inserted one peg in the upper and two in the lower fragment. One of the latter pegs was notched to break off one inch from the point as the others had been, but owing to a flaw in the ivory as well as being very deep and

tightly gripped by the muscles it broke off about an inch and a half long instead, thus leaving about half an inch projecting above the bone. In spite of this the three punctures healed in twenty-four hours without the development of any pus or constitutional excitement then or afterwards. Thus far we demonstrated the safety and practicability of performing Dieffenbach's operation by the subcutaneous method, and I wish I could add, at least for the patient's sake, that our operation had achieved its intention of exciting local action in the bones, but after giving him plenty of time and rest the fracture is now as loose as ever. The pegs are not felt; in fact, at no time did they give rise to so much local action as we could have desired, and I cannot but think that in this case the patient's osseous system must be unusually tolerant of injury. The operation has failed in this case, the only one in which it has yet been tried, and is so far a discouragement to any further trial of it, for after all "nothing succeeds like success;" but it should be remembered that in this case Dieffenbach's own plan would have failed, and that in many after everything has been tried, amputation has been found necessary.

One point worthy of notice is that in case of the pegs' exciting suppurative inflammation and the formation of abscess requiring the laying-open of the fracture the patient is in no worse position as to the wound than the original operation requires; but it must be confessed that in these days of antiseptic surgery the exposure of bones and even of joints is not the formidable thing of the past. Respecting the apparent disappearance or absorption of the pegs in the foregoing case—for no trace of even the broken one which projected into the soft parts appears to be left—it is interesting to recall Mr. Savory's experiments on the absorption of dead bone ('*Med.-Chir. Trans.*,' vol. xlvii, p. 103). From these it would appear that one essential towards absorption is firm contact, as in a peg tightly driven into a hole, one which is loosely placed not being affected. To sum up, the operation is, as it always has been, scientific from a physiological point of view; the new modification of it must be allowed to be practical from a mechanical as well as a physiological point

of view ; its utility requires to be further tested, and I trust will be notwithstanding the cloud of failure which overshadows its first trial. It may be expected to succeed in any case in which Dieffenbach's method promises success, and likewise to fail where that operation has hitherto failed. The supposed influence of phosphorus over the production of new bone has not received any support from the history of this case, for the patient took it regularly for two or three months, and the present condition of the fracture is perhaps looser than ever ; the ends of the fragments are atrophied, rounded, and overriding, although the shortening is only from half to three quarters of an inch. I find it impossible to give any adequate cause for the refusal of the bones to unite in this case. As I have said, the patient is apparently of untainted constitution ; there is no history of excesses, syphilis, cancer, scurvy, or scrofula ; he is well nourished (rather inclined to over-fatness if anything), and the only thing which the mind in casting about for a cause can invest even with a shadow of suspicion is that he has had acute rheumatism more than once, although not lately. But against this we know that wasting, atrophy, or degeneration of bone from rheumatism is only found in very chronic cases (Paget, 'Surg. Pathol.,' p. 304), and mostly at the articulations ; moreover, all experience is against the supposition that changes from this cause have much influence until the patients have become somewhat advanced in life. I am satisfied that, if any portion of the soft tissues by intervening between the fragments had prevented union, this obstacle would have been long ago removed by absorption due to the firm pressure to which the limb was subjected in the apparatus before referred to. It may be that, the fracture having occurred below the entrance of the nutritive artery, the fragments have not received sufficient blood to carry on vigorous nutrition (for the influence of this condition see Mr. Curling in 'Med.-Chir. Trans.,' vol. xx) ; but this hypothesis may be fairly met by the objection that hundreds of other femora unite for one that fails, although all the fractures may be pretty much alike as to position. Undoubtedly motion was the main cause of non-union at first, but in the subsequent treatment this was carefully guarded against, as was also every

other possible cause of aberration, so that the conclusion seems inevitable that "it is an example of arrested development of the reparative material, and may be in this respect compared with the condition of granulations whose cells persist in their rudimentary form."*

For fuller details and authorities consult Mr. Hornidge's admirable article in Holmes's 'System of Surgery;' see also Gross's 'System of Surgery,' London and Philadelphia; also Norris in 'Amer. Jour. Med. Sci.,' January, 1842, the fullest article on the subject of non-union in fractures.

* Paget's 'Surg. Pathol.,' p. 193.

Note and postscript, 2nd December, 1875.—On the 12th of last month, and after the foregoing paper was sent in to the Editor, I resected the ends of the broken femur. The difficulties and trouble of this operation were so great, especially in baring the lower and deeper fragment, that I must endorse Mr. Rowland's opinion, who stated that he should hesitate to recommend it ('Med.-Chir. Trans.,' vol. ii, 1813). So many others have also testified to the same dangers and difficulties that the operation of subcutaneous pegging, which may be done with ease and certainty, should have further and more extended trial in the face of such a formidable alternative.