THE APPLICATION OF SUTURES TO BONE
IN
RECENT GUN-SHOT FRACTURES,
WITH CASES;
ALSO REMARKS ON THEIR SIMILAR USE IN SOME
OTHER FRACTURES AND OPERATIONS.

BY
BENJAMIN HOWARD, M.D.,
FELLOW OF THE COLLEGE OF PHYSICIANS AND SURGEONS, NEW YORK;
LATE ASSISTANT-SURGEON, REGULAR FORCES, UNITED STATES ARMY.

COMMUNICATED BY
JOHN BIRKETT, Esq., F.R.C.S., Hon. Sec.

Received April 11th—Read June 27th, 1865.

THE dangers incident to the necessary transportation of gun-shot fractures from the battle-field are usually greater on long campaigns than those belonging simply to the wound *per se*.

Although from the beginning the advantage of primary operations seemed to be generally appreciated during the early part of the recent rebellion, there was, perhaps, a dangerous care to operate only in compliance with the immediate demands of the case; for in the official consolidated statement for gun-shot wounds for September, October,

November, and December, 1862, published by the United States Medical Department, we find that out of 228 cases of excision of the upper extremity, 195 are reported as secondary operations; while out of 521 amputations, 401 were secondary. There is every reason to suppose that the greater part of these secondary operations would never have been called for could the patients have remained at rest. Transportation, however, being inevitable, the successful surgeon learns to anticipate the innumerable contingencies growing out of it, and to adopt that present course which shall avert the greatest ultimate danger.

The tendency of the military surgeon to rush disheartened from extreme conservatism to reckless amputation has arisen mainly, not only from humiliating failure in saving the limbs, but in too many cases from the sad fear of having, in the most careful attempt to save their limbs, unfortunately sacrificed the lives of certain patients. The commonest cause of such failure has been the extreme difficulty, I may add the impossibility, of preventing such painful and dangerous motion of the fractured limb during transportation.

As it seemed hopeless to anticipate an improvement in the mode of transportation, the only attempt which seemed practicable was so to improve the condition of the limb as to diminish the motion of the fractured ends of the bone *en route* to general hospital.

Humanely anxious to preserve what often cannot be saved, the surgeon may direct a gun-shot fracture of the humerus to be put up firmly in splints, and the patient to be placed in an ambulance; but let the dressings have been applied ever so well, from the jarring and jolting, through rough fields and woods, they soon become disarranged; the previous firmness of the dressings but increases the now unequal pressure and constriction about the swelling limb, which usually cannot receive the necessary attention during the march.

The inflamed and strangulated wound, containing innumerable loose fragments and spiculæ of bone, which for successive days, perhaps, are being ground together between the

sharp-fractured ends of the shaft, is so much further irritated by the constant mangling of the soft parts that it is not uncommon to see a patient after a few days in the ambulance beyond any hope even from amputation.

Removal of the loose fragments and resection of the fractured ends of the shaft of the humerus has frequently been resorted to, but the chief difficulty still remained. The inevitable motion came, and the surgeon receiving the case at the general hospital would denounce the treatment as barbarous.

Hoping to steer equally clear of Scylla and Charybdis, I communicated to the Surgeon-General of the United States Army in 1863 an official document, in which I proposed a treatment specially for gun-shot fractures of the humerus, which, wherever applicable, would, I thought, supply the desideratum so generally felt.

It consisted in cutting down upon the seat of fracture, as in ordinary resection, removing all the fragments and spiculæ of bone, making a clear section of the fractured ends of the shaft, effecting perfect apposition, maintaining it by metallic sutures, and with the assistance of a light splint securing both *apposition and rest* during all the contingencies of transportation from the battle-field to general hospital.

The details of the operation are exhibited in the following case :

On the 12th of May, 1864, during the Battle of the Wilderness, Virginia, I was requested by Surgeon-Major Hubon to see Private Meisner, Company E, 52nd New York Volunteers. A Minié ball had perforated his left arm, producing oblique fracture of the middle of the shaft of the humerus, accompanied with severe though not extensive comminution. With the kind assistance of Surgeon Hubon, I enlarged the wound of entrance, making a straight longitudinal incision as external and dependent as possible, and as small as was consistent with the subsequent steps of the operation. Having removed all the detritus and loose fragments, the ends of the bone were turned outwards carefully enough to avoid peeling up of the periosteum, while with a metacarpal saw I made a section, removing the ends of the bone at such parallel ob-

liquities as to create the least possible shortening compatible with clean-fitting surfaces. After satisfying myself that, while the ends were in perfect apposition, there was no deflection of the line of axis of the bone, I drilled two pairs of holes obliquely through the ends of the bones as nearly as possible in the same line of diameter of the bone.

Through each pair of holes I then passed a suture of stout annealed iron wire, and secured them by twisting, as with silver wire in other parts. The ends were then nipped off short and turned down out of the way over the line of junction.

Fig. A.—1, 1. Shows length of fracture. 2, 2. Amount of bone removed.

Fig. B.—Condition after operation. 3, 3. Line of junction, with the two sutures used.

The amount of bone removed was considerable, from the obliquity of the section, but the shortening was not more than an inch, as seen in figs. A, B. The edges of the wound were, therefore, readily approximated with sutures.

A straight splint was then applied, extending from the axilla to the tips of the fingers, which was kept in position by a simple retentive bandage only, fully exposing the wound,

which the patient was directed to keep wet with water from his canteen.

From the 12th of May the patient was left in the forest in the hands of the enemy, without any attention or shelter, until the 17th, when he was transported about fifteen miles to Fredericksburgh. On his arrival the wound was full of maggots; these were cleared away and an examination made, when I was pleased to find that, notwithstanding these most trying circumstances, the ends of the bone were perfectly intact. From that time I attended the patient daily up to the 21st, during which time his pulse ranged from 88 to 96; he had a good appetite, and slept soundly. After the 19th there was no undue congestion of the wound, and the pus discharged continued moderate in quantity, and of a fine healthy character.

After the patient was sent north I was unable to obtain further particulars of his case, but I subsequently received an official statement from his commanding officer, to the effect that he had returned to duty and had since been transferred to another regiment.

As regards the manner of performing the operation.

The *incision* should be as small as is consistent with the subsequent steps of the operation, it being of primary importance that there should be the least possible disturbance of the soft parts; especially does this hold true with the periosteum.

The incision should be as dependent as possible, to allow of ready drainage of subsequent discharges.

If I have found a sound periosteal covering to any of the bone to be removed, I have dissected it up and afterwards brought it down over the line of junction.

The *drill* which I invented for the performance of this operation in the field, a description of which was published in the 'American Journal of Medical Sciences' for April, 1865, has the advantage over others in this operation in its being

so small that it can be used with more facility without turning out so fully the ends of the bones. It works more rapidly, has no prominent points which can become entangled with the tissues, and the drills, fitting into the locket with a bayonet fastening, are in no danger of sticking fast to the bones and remaining behind on attempting to withdraw them. It also affords advantages for drilling at any desired angle with the surface of the bone. The drills are only two sizes larger than the sutures to be used.

It is important that the holes be drilled not through and through each end of the bone, but through one thickness only of the cortical portion each time, boring obliquely from without inwards twice through each end (*vide* illustration figs. d and c), so as to form two corresponding pairs of holes

Fig. c.

Appearance after application.

Fig. d.

Mode of applying the sutures.

as nearly as possible in the line of the diameter of the bone; the advantages are that only half as much bone is included within each loop of the suture, and may thus be extruded in half the time otherwise required; or, if desired, its removal may be much more readily affected. The two sutures, besides giving greater strength than one if they be introduced in the line of the diameter of the bone, they prevent any hinge-like motion and consequent danger of snapping.

The sutures employed were of annealed iron wire, the largest I could find having the necessary pliability. I think, however, that plated copper wire would be preferable, if it is intended to remove them after union, or should it be intended

to leave the ends protruding at the wound, so that the natural process of extrusion may be aided by frequently giving an additional tightening twist, so as to hasten the absorption of the part contained within the loop.

Contrary to any previous expectation, the circumstances of the following case led me to extend this plan of treatment to a case of fracture of the femur.

May 29th, 1864, I was called in consultation on the field to see Private I—, Co. B., 6th Ohio Cavalry. The patient, who was sixty years of age, and of broken-down constitution, had received a severe fracture of the femur from a large fragment of shell, which I found firmly wedged into the bone about three inches above the knee. From this point there proceeded a long oblique fracture, running upwards and outwards, with some comminution of the inner aspect of the bone in the vicinity of the piece of shell. The sharp-pointed lower fragment was overriding the upper, causing a shortening of about three inches, reduction of which, with such a wound could not possibly be maintained, with splints alone during transportation. Having made the requisite incision, and extracted the impacted piece of shell, I proceeded to remove the looser fragments; then, causing steady extension to be kept up while I kept my finger and thumb in the wound, I guided the fractured ends so that the corresponding serrations were accurately refitted to their original position for about two thirds of the circumference of the bone. Having somewhat enlarged the incision, I directed the limb to be so bent upon itself as to slightly reopen the fracture while I drilled the requisite holes, and passed a suture which firmly secured the interlocked fragments, rendering shortening or shifting impossible, as in fig. E. A straight splint was then applied, the wound being left exposed for the repetition of cold-water dressings. After the operation the patient ceased to complain of pain, and seemed very comfortable. The next morning he was hurried away in an ambulance train, and I saw no more of the case.

In consideration of his age, the nature of the wound, and his broken-down constitution, I was not surprised when sub-

sequently I incidentally heard that he died on the road three days afterwards.

Fig. E.

1. Impacted fragment of shell. 2. Suture retaining ends in apposition.

The shock of the operation involved in this plan of treatment, superadded to that of the original wound, immediately suggests itself, of course, as an objection to its adoption. Over against this, however, we must weigh the immediate dangers previously enumerated from the pressure and constriction of tight dressings attending the use of simple splints. Those from the enclosed fragments and spiculæ during transportation being in continual motion, and afterwards awaiting tedious extrusion by the slow processes of nature, keeping the patient in a condition which renders him continually susceptible to various intercurrent diseases, and, should union be ultimately effected, the degree of effort called forth for its accomplishment has left behind such a surplus of provisional callus, and other pathological changes in the parts adjacent, as seriously to diminish the usefulness of the limb for a long period, with a still further danger that after apparent recovery tertiary sequestræ, as mentioned by Dupuytren, may continue to be extruded for ten, fifteen, or even twenty years thereafter.

In the operation described the chief causes of the evils above enumerated are removed. *Its advantages consists mainly in this :*

1st. *Negatively.*—*In the absence of everything which may act as a foreign body and dangerous source of irritation.*

2nd. *Positively.*—*In securing complete coaptation and perfect rest.*

This plan of treatment is new only in its application. Sub-

stantially the same operation, including the use of the wire suture, has for a long time been practised, and still meets with general approval, as a *secondary* operation for ununited fracture.

Other things being equal, why should it be less advisable as a *primary* one, where, in the absence of all pathological changes, we have a healthy condition of all the parts, with sound bone in apposition and at rest.

These considerations led me to hope for a healthy process of uninterrupted repair, with speedy use of the limb after union.

The selection of the cases (which at most must be quite limited in number, either on the field or in civil practice), the amount of bone which may be with propriety removed, &c., must, of course, be a matter of careful judgment.

As it will probably take a long time to collect reliable histories of the cases of this kind which I sent from the field to different hospitals in the various states during the campaigns of 1864, it would be unwise for me to anticipate what I hope to be able to state in a full report hereafter.

While taking occasion to bring this plan of treatment before the notice of this Society, I would suggest the similar use of wire sutures as a retentive appliance in certain cases in civil practice, especially in cases of compound fracture with great displacement, with or without section of the ends of the bone, where but little additional enlargement of the wound is necessary for the operation.

In Pirogoff's operation, should it be practised, where one suture would counteract the troublesome traction of the tendo Achillis.

In fracture of the jaw, where I have found it to answer admirably.

With or without section, as the case may demand, I consider that the use of sutures in the treatment of fractures is a valuable accessory of which the surgeon may sometimes avail himself with great advantage.