On the cause and treatment of
ununited fractures.

by

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Very Sincerely
In looking over the Reports of the Surgical Cases of the various large Hospitals of the United Kingdom, it is satisfactory to perceive, that considering how numerous and diversified are the fractures which are admitted into those Institutions, how few there are which fail in undergoing the natural process of separation and are restored to an almost normal condition. It is true, there are an immense number of cases, in which some slight deformity or other, is almost impossible to be
Avoided, but the total want of union is comparatively rare.

This success is due in a great measure to the careful and scientific manner in which the injuries of bones are treated.

But as we shall attempt to show hereafter, an unfortunate result may occur, where even the greatest skill on the part of the surgeon can scarcely be expected. Has been expended.

As to the frequency of non-union, Malgaigne in his work on fractures, says, that he do not get poppets satisfactory statistics. Sir Stephen Hahnemann had only three cases in his practice, Lister
had but one. Pearson one, out of 367 cases of fracture, Lonsdale saw only one in 1,600 cases out of 4,000 cases of fracture treated at the Middlesex Hospital.

The Causes of bone fracture may be properly be grouped under two heads, viz. Mechanical and Constitutional. Malgaigne divides the causes into three, viz.: Those which affect the system generally, those which are connected with the position of the fragments, and lastly, those which are connected with the position.
We may place first among the mechanical causes of non-union, want of apposition of the broken surfaces, with an interval more or less extensive between the fragments; it is obvious, that union will be the more difficult, the greater the gap that exists.

Another and not a very easily detected cause is the intervention of some foreign tissue between the fractured ends, as happened in a case of fracture of the humerus, under Sir James Barke at Bartholomew's Hospital, where the lower fragment was found to have penetrated...
The Biceps muscle.

Want of perfect rest of both broken extremities, caused either by the unavoidable movements of the patient, as happens in military surgery or otherwise, is one of perhaps the most common causes of syncope.

According to Larrey, this was particularly remarkable in the cases which occurred to the French soldiers in Syria.

He says, that the gunshot wounds of the extremities, complicated with fracture, especially with that of the humerus,
were almost all followed by the formation of accidental joints.

In addition to the above, the following may also be classed under the mechanical causes of non-union—Loose splinters of bone, occurring usually in severe comminuted fractures. An blow, a lady, a necrosis, or other suppurring disease near a fracture. And yet we may have a large delation of bones, with perfect union occurring at the time, as in case of a woman under Mr. Partridge in King's College Hospital.
with a severe compound fracture of the tibia; the upper fragment protruded anteriorly about 1/2 inch. Part of this was sawn off and the bones set as accurately as possible, but the wound being large, a portion of the anterior surface of the tibia, nearly two inches long, came away.

It is common to notice in compound fractures, that whilst the wound suppurates freely and while there are spicules of dead portion of bone unextracted, no solid union takes place.
Astley Cooper says, that many cases of false joints, are due to the too long continuance of cold applications to the part, thus checking that degree of inflammation necessary to bring about a restoration of the parts.

The ligature of the principal artery of the limb has been stated to favour gangrene.

And lastly, if a fractured limb, is used too soon, the callus is likely to be absorbed from pressure, and the limb is crippled, or an accidental slip.
May fracture the callus.

Having thus taken a general view of the mechanical causes, we must now turn our attention towards the constitutional, and these are fully as various, though perhaps not such constant causes of non-unions. According to Amstead only a very small portion of the cases of pseudarthrosis are due to constitutional causes.

Almost every surgeon of large experience has met with cases in which, he
patients were apparently healthy and the fractured extremities in perfect connection. And yet on examination, he finds no union taking place.

Fracture in patients afflicted with cancer, syphilis and rickets are stated to be difficult or even not to unite at all. But the opinion of Sir Benjamin Brodie is of importance in this point: In speaking of the occurrence of broken bones in consequence of disease, he remarks, "I know that..."
The rule is not absolute, for in a great many instances where the bone is fractured it will unite perfectly. He then goes on to cite several cases, where fracture occurred in cachectic patients, from cancer of the bladder, and perfect union nevertheless took place. Fractures occurring in pregnant women may unite, but they are seldom firmly consolidated till after delivery.

The effect of injury on fractures, as exemplified in the well-known cases that occurred in Lord Anson's voyage, is particularly remarkable.
That a syphilitic taint does not favor union, I may mention a case that occurred to me last Summer, it was the case of a girl about 19 years of age who broke her left radius twice: the second fracture was occasioned by a violent blow about ten days after the first. Left off, the splints for the first fracture; the first fracture had been firmly consolidated, and the second united perfectly. Yet during the whole of that time she was being treated for an extensive general eruption of some throat.
A proper supply of food and of good quality is for the best part required in the treatment of fractures. Union has been known to be retarded by depriving the patient, of his or her accustomed supply of ardent spirits.

The period which is usually allowed for the firm union of broken bones, varies greatly, the bones of the lower extremity, requiring a longer period than the ribs or the bones of the upper extremity; consequently it
It is not within our power to say distinctly, at what exact period of time a false joint is formed; but according to the best authorities in this subject, if, after the lapse of six months, the ends of the bone be still moveable, a false joint is decidedly present.

It was formerly supposed that, in case of non-union, the two extremities of the bone, undergoing such a change as to resemble, in almost every particular, a perfect antherosial joint.
But attention have forced that this is altogether erroneous idea, but even at this period, Medical authorities have not quite agreed upon this point.

The following are the few views of some of the men, who have devoted a good deal of their attention to this subject.

According to Boyer, the ends of the fracture, which are sometimes rounded and sometimes pointed, are connected together by a cellular ligamentous
Substances, but their surfaces are not covered by a smooth cartilaginous matter, but in these constantly a capsular ligament.

But in the forearm, the ends of the fracture may assume a structure, which bears a greater resemblance to an articulation.

Lagenbeck observes that the edges of the fragments heals and resemble those of a bare lip. When the broken ends are constantly moved, the end of the bone becomes excavated, in the form of an
articulac cavity and a sort of ligamentous structure connects the two ends.

On this subject, John Hunter expresses himself thus: "Sometimes delicate fractures will not unite at all. In these cases the surrounding part, harder and form a kind of capsular ligament and the extremities of the broken bone rub against each other; at each motion of the limb, by which stimuli the broken parts are absorbed and the extremities become smooth and in
tissue covered with something similar to cartilage, and at length the cavity between them becomes filled with a fluid very much resembling synovia.

In many cases the ends of the bone are rounded and enveloped in a thick fibrous ligamentous capsule attached to the ends of the bones above and below, and its internal surface is lined with a smooth membrane, bearing a strong resemblance to synovial membrane and like it capable of secretion.
Professor Miller gives a more definite description of what are the appearances presented by a false joint, he says.

"The false joint which results either from disunited or from ununited fracture, bears no resemblance to normal articulation. There is neither articular cartilage nor synovial membrane. The ends of the bone taper somewhat and are rounded off; they are invested by a dense fibrous expansion, and by a similar texture of less density. They are joined together..."
Very slight rumor exists.
The main object in both is to put the two extremities in the condition of recent division, that is, by producing in them a suitable degree of inflammation.

The different operations that have at various periods been proposed, are as follows veg

1st Rubbing the fractured ends against each other — John Hunter
2nd The use of an apparatus for preserving Amesbury
3rd. The application of Caustics.

4th. Sawing off the ends of the fracture, commonly called, Resection. Wits.

5th. The introduction of a needle by subcutaneous incision, and scraping the ends of the bone. Prof. Miller.

7th. The introduction of living frogs into the broken extremities. Differenbach.

Of all the methods for the care of fractures, the simplest is that of rubbing the broken ends against each other; and this plan is of very ancient date, for,
John Hunter recommended this practice and he was in the habit of ordering his patients to walk about on crutches, and to use the affected limb (if it happened to be the leg) having first well supported the extremity by splints. This may be very proper treatment...
where no articulation exists, or where there is no ligamentous connection, but when we have a false joint perfectly established, the treatment would probably be of little use.

Mr. Armstrong proposes a plan, which appears at first sight to be the mildest, but which in reality is so painful and tedious and the result so uncertain, that so far it has met with little encouragement. His treatment is to keep up a continued
and considerable prepare for some weeks, so that the fractured ends are firmly fixed together. As particular apparatus is required in these cases.

Amesbury mentions cases which have limited by prepare after, six, eight, ten or even sixteen months have elapsed since the accident; but in these cases it is probable that non-union depended greatly, upon a deficient earthy deposit, or rather, on a very slow and gradual deposit of earthy matter in the callus.
Dr. Syden in an ununited fracture of
the femur, succeeded in obtaining union
after a period of six months, by
employing the long splint, with this
modification. He says, in cases of
this kind, the limb is always distorted
from the imperfect resistance opposed
by the broken bone to the contraction
of the muscles, and these new results
an arched form of the thigh. In
the convexity of this arch which is
directly outwards and forwards, a
cushion, formed of the sheek of the
of a table cloth, folded up to the requisite size, is placed and made to rest on the long splint, which is then drawn tightly to the knee and pelvis.

The repeated application of blestews on the surfaces opposite the seat of fracture has been recommended, six or eight
weeks after the accident. (Antarization of the skin with Caustic Potash and painting with Frictione Iodinii, have
also had their advocates.)
Various causticants have been employed in these cases, with the view of destroying the abnormal textures and arousing sufficient inflammation for the deposit of new bone. Among these we may mention: Strong nitric acid, Caustic Potash, Bacter of Antimony and Bichrome of Silver. Among this class of remedies we may perhaps properly include that of introducing a metallic cannula between the bones and with a steel probe dipped in boiling water, and the
Injection of some irritating fluid into
the wound.

In South of St. Thomas's Hospital gives
a case in which caustic potash was
used by the younger Blane, with
success in the broken tibia of a sailor.

Newton is also said to have had a
similar successful case.

A fracture having failed to unite by
the employment of the above means,
the surgeon is forced to have recourse
to more energetic measures and to
adopt a plan of treatment of course more dangerous to the patient.

And here the suggestion naturally arises that if the ends of both bones, were cleanly sawn off, he might almost be sure to bring about union. But, practice has not justified the feasibility of this theory, for at the very outset, he meets with the following formidable objection, viz. the conversion of the simple into a compound fracture.
a change of a very serious and important

nature.

This operation however has been performed several times; the honour of introducing this operation to the notice of the medical world, belonged to Mr. White, and in his hands the operation was in some cases successful.

He performed the operation upon a broken tibia, and in twelve weeks the bone was firmly united. The last case in which it was tried, I believe
was a. King's College Hospital. There
I had an opportunity of taking notes
of the case, but it proved fatal.

The following is an outline of case.

October 5, 1867.

Mr. J. B. 42, a sailor of a very stout and
heavy build, broke his back to the right
flank two years ago whilst in North
America. A few months previous, he had
undergone all the local measures resorted
to in these cases, but without benefit.

The false joint was situated at the junction
of the middle with the lower third
of the bone, and was very movable.
About two o'clock this day, chloroform having been administered, Dr. Ferguson, made a longitudinal incision, 3½ inches long, on the outer side of the limb, continued into a transverse one about the same lengths, just above the talar joint. The flap was then deflected off, and the femur exposed, a piece of the upper fragment about an inch and a half in lengths was now removed by means of the saw, but portion of the lower
fragment, which was very deeply situated, were obliged to be taken away by the cutting glands and bone was after-ward scraped. The lips of the wound were then brought together. During the operation, the extremities of the fragments were found to be smooth and rounded, just as if, each of them had been surrounded by a capsular ligament, though there was not an actual synovial cavity between the bones.
About half an hour after the operation there was a slight hemorrhage from the wound, but it was easily stopped by cold cloths. The greatest care possible was taken by means of the long splint and bandaging to keep the ends of the divided bones in perfect coaptation. Starting and slipping of the limbs was the only thing the patient complained of, the first three days. A piece of lint was then kept on the wound for the double
purposes of cleanliness and keeping up a sufficiency of action: In the evening of the 7th, seven days from the operation, he became somewhat feverish and thirsty, and complained greatly of severe pain in the limbs. The appropriate measures were taken to relieve the feverishness, which abated considerably, but on the 8th he experienced an attack of shivering which lasted a quarter of an hour: effervescent draughts, wine
And nourishing diet were ordered, and
the bowels kept gently open. He went
in pretty well for three days, but again
experienced another severe seizure.

Every evening, he became tranced,
and the tongue was flushed.

He was very thirsty, and the pulse rose
to 104. These fits occurred often
and followed each other very rapidly, and
the pulse became frequent and small.

And in the evening of the 28th, he
vomited a fluid of the colour of
coffee grounds and dried soon after.

Post-mortem examination, thirteen hours afterward. On exposing the affected femur, a portion of necrosed bone was found between the ends of the fragments.

Several large branches of arteries were given off near the fracture and the veins in the neighbourhood of the fracture were quite healthy. No justulent deposits were found in the liver, spleen or kidneys. The bladder was contracted
but healthy, and the aortic values were slightly thickened.

Barron Dupuytren deemed the removal of one end of the fracture to be sufficient, and he narrates a case where the operation was performed on the lower jaw with entire success.

Lawrence’s observations on Charles White’s operation of sawing off the ends of the fractured bones, as follows:

‘If the operation be in the fleshy part of the thigh, it must be a very
difficult thing to accomplish, you have to inflict a very severe wound, a wound very likely to be followed by considerable inflammation, and that, with still more severe effects. In many instances in which this has been done, the patient has been left in a worse condition than he was before.

Professor Miller was led to propose and put in practice a new mode of treatment when the plan of subcutaneous incision came into vogue. His method is to pass a strong needle obliquely down
to the fascia and to move its edge freely about in all directions, so as to cut up the ligamentous bond of union, as well as the dense investments of the ends of the bone. The needle is then withdrawn and the wound healed by collodion or plaster. By this irritation, the part will most probably be reduced to a state very similar to the primary fracture. The connecting materials of the false joint are disrupted & restituted, not destroyed & when brought into & maintained in a state of moderate vascular excitement,
They affect greatly in the formation of bone.

In the Monthly Journal of Medical Science, June 1840, Prof. Milne gives a case of ununited fracture of the Humerus, from a compound injury received ten months previously. This case was of so unpromising a nature, that at the time of the operation, he remarked it was an unfair test of the operator’s practice. Yet on removing the splint, five weeks after the operation, the parts were found quite firm. I believe that Prof. Thompson performed the same operation with success.
In an unremitting fracture of the Humerus of a child, about two years ago, I have not been able to discover any case in which this operation has been performed on the lower extremity.

All surgeons, however, must allow that the above treatment is infinitely preferable to that of John Hunter, although there is some slight resemblance between the two. The operation as performed by Hunter, was as follows: There was an artificial joint of the Humerus, he made an incision into it,
lower jaw in this way.

Mr. J. B. Dowel of Dublin in the London Med.

Gaz. vol xiv. p. 676. gives two cases of

ununited fracture of the femur and

humerus both treated by the delto, the

former was successful, but the latter not.

In the last case, the man's constitution

was greatly broken down by convulsions.

It is probable that many cases, in which

this operation has been tried, have failed

from removing the delto, before bony

matters has begun to be formed.

Acupuncture in these circumstances has also
had its admirers, but the records of surgery do not speak much in its favour.

Galvanism has been brought to bear on this subject by Dr. Burman, and he produces a successful case of unilateral

fracture of the tibia of fourteen weeks duration: but in this case, the patient was put on more generous diet and a constant strain. Pressure was kept on the fractured ends, so that we cannot altogether fur our faith to the fact that the electric fluid


as it conveys our bonds & wishes from
the extremity of the kingdom to the other,
so it will certainly cure our unceasing
fracture.

For the last operation recommended
and put into practice for the removal
of pseudarthroses, we are indebted to
Differentbach. And it is to this
last operation I would more parti-
cularly refer, as when I was surgeon
of King's College Hospital, I had the
good fortune to assist and have
the change of a case of this kind, operated on by Mr. Bowman.

I believe there are only three cases recorded of its performance in England, once by Mr. Tate of Leeds, by Mr. Stanley at St. Bartholomew's and lastly by Mr. Bowman.

The circumstance which led Dieffenbach to adopt this operation, is a striking illustration of the benefit we may hope by a close observation of the various pathological changes to which the human body is liable. In examining...
some osteological specimen, he discovered that a quantity of opaque substance had been thrown out, round a bullet which had been lodged in a bone. His mode of operating was as follows: he exposed the bone by an incision, then drove a peg of ivory, about half an inch from the seat of fracture, into each cellularity and then firmly and closely connected the two by means of a wire. Dr. Stanley omits the wire, but in almost every other particular follows Dieffenbach.
I shall now proceed to relate his case.

Abraham B., at 24, a healthy Countryman, has been employed as a "brake" in the Great Western Railway. He always enjoyed good health and is of temperate habits.

Two years ago, he was knocked down by a horse; by this accident he suffered a compound fracture of both bones of the right leg, at the lower third. So great was the violence of the injury, that the upper fragment of the bone was forced through his Wellington boot. Great difficulty...
was experienced by a medical man at
Slosh (where an accident occurred) in reducing
the fracture, but after nearly an hour
continued extension, it was accomplished.

The limb was put up in splints for two
months, as in Simpson's splint apparatus,
for four months, but no union took
place, though the wound healed readily.
At this time the patient being rather
out of health, he was sent into Devonshire
and whilst there, he managed to open
the inconvenience of the pseudarthrosis,
by making for himself an inferior
apparatus consisting of iron hoops and a connecting rod. This state of affairs lasted for eighteen months, and he was finally recommended to apply to Dr. Hanley, under whose care he was admitted October 7th, 1850. Two years since the occurrence of the accident.

On examination, the fractured portion of the limb, allowed of excessive motion, a false joint had been formed, and the brain complained of a peculiar scraping or grating sensation at every step he took.
In Stanley first tried Blistes for a month.
Then splints, and various other contrivances,
among which was a casing formed of fun
of chalk; but without any beneficial effect.
The patient was again sent into the country,
and after a short stay, returned much
improved in his general health.
On February 15th, 1831, Mr. Stanley decided
upon driving iron pegs into the
extremities of the fragment: the patient
was placed under the influence of
chloroform and a flap of integument over
The fracture having been reflected, Mr. Stanley bored four holes, with an instrument of the clap of drills, made for the purpose.
Into these four holes, four ivory pegs were inserted or cleft and hammered in nearly a 1/4 of the peg remaining over the surface of a bone. The flap was then replaced on the patient's leg, but into a fracture box. Inflammation ran tolerably high, suppuration was soon established, without much constitutional disturbance, and the pain...
was very trifling. Three days after the operation, a small abscess formed on the upper part of the flap, this was opened, and a fortnight afterwards, something was observed projecting from the wound, and when pulled out, it proved to be one of the flaps: the flap was cicatrized and two months after the operation, Mr. S. proceeded to remove the remaining flaps, the soft parts having been laid open for the purpose. It was found on examination, that the portion of the leg,
which had been above the surface & bore
was quite unattacked, whereas the flesh, &c.
had been embedded in the aqueous substance
had nearly disappeared. On the 18th
of May, three months after the intesina
tion of the injury, the man suffered from
a sharp attack of dysipelas of the leg.
This was prevented, from spreading by a
circle of nitrate of silver, round the upper
part of the limb and manual remedies
soon restored the leg to its normal
condition. An examination was made
about this time, and the leg was found
to be getting firm, but motion was not
yet permitted, and about four months
altogether after an operation, the fracture
was found to be firmly consolidated.

It was kept as an In-Patient for
a month longer, and was discharged
toward the end of July 1857, with a
sound & serviceable limb.

Before detailing Dr. Bowman's case, it
will perhaps be proper to make
some remarks on the manner of
proceeding, as adopted by Sir Stanhope, and to suggest, with all due deference to so high an authority, one or two points in the operation itself. It must be obvious to every one, that the first step of the operation resembles that of sawing off the ends of the bone, except that a flap of integument is first raised for the introduction of the pegs; this evil, or, to a great extent, avoided by Dr. Bowman, in the following way: he first clearly ascertains the position of
The broken extremities, by means of a small forceps, or rather a large pin, is then made a simple incision at once down to the bone, and through this aperture, as it were, he drains the flegm much in the same manner as Dr. Stanley. The edges of the incision are brought together by strips of adhesive plaster and more than probably, union by the first intention later. Place, it occurred in the two lower incisions in his case.

Again it is well known, that if bone
is crushed, it must inevitably die, now then, in the application of the drill and the forcible introduction of the pegs, more or less, bone must be crushed, perhaps it is too small in quantity, as to be carried away in the dephosphatation that ensues: but it seems to me, that if a very small trephine were used, it would obviate any ill consequences, that might arise from the above cause: and the pegs might be so made as to fit to a nicety the aperture made by the trephine, so
I am fully aware that this is decided by the very highest authorities.
as to require little or no hammering.
In the case I have alluded to, we have a
convincing proof afforded us, that those
parts of the flags, which were in intimate
connection with the living bones, being
undergoing a process of absorption, they
presented just the appearance, that
the meet, with every day in the milk
bodds of children. Now, if the flags
were totally embedded in the bone, it
is most reasonable surely, to suppose
that the whole would be absorbed, and thus a second operation would not be required, the knowledge of which, should it by some accident reach the ears of the patient, would most likely act in a very prejudicial manner in regard to the issue of the case. And even should they not be absorbed entirely, how many cases are there not recorded, in which bullets have remained for years a years embedded in various bones without any ill effects.

I will now give Mr. Browne's case,
And I am sorry, it is not in my power to give it in a more finished state, for since I left London, the spirits have been removed, and although there is no longer that intense motion there used to be, yet the head is by no means firm. The boy being out of health, from long confinement to the hospital, is to go into the country for a short time, after which I believe the Rousman intend, to introduce one or two additional pegs. So that, I still hope to have the pleasure of laying the successful termination of this case, before you.
December 16, 1850.

William Lawrence, aged 13, a fair complexioned lad, fractured both bones of the right leg, in the lower 3rd, when he was only 3 months old. The surgeon who was consulted by his parents recommended that both feet should be placed in one stocking, so that the child should be kept still. Probably owing to the condition of his parents or the movements of the child, union did not occur despite deformity resulting. He has been able to walk by the aid of a stick, and today walked from his home to the Hospital, a distance of 9 miles. This is the state of the limb, the fragments are connected by a ligamentous band at an acute angle. This angle forms a
Projecting stump, that is brought, in walking, into contact with the dorsum of the foot, the consequence has been the formation of sores on an opposing surface.

I have attempted to give a rough outline of the general appearance of the leg. There is no ankylosis; it keeps its natural freedom of movement between parts. There is considerable motion in the ankle joint, flexion and extension almost perfect. The toes have free action. The interosseous membrane has been inflated, and the ends of the upper fragment diverge a little, so that the extensor tendons have sunk between them. The tendo Achillis is turned backward, forming a prominent bursa behind. On the 24th of January 1857, Mr. Bowman divided the tendo Achillis.
Subsequently, he then exposed the extremities of the tibia and fibula by separate longitudinal incisions, and having removed about an inch from each of the lower and upper fragments, he brought the fragments together, reducing the limb to nearly a straight position. The limb was then placed in a deal splint, or slung in a cradle. A good of constitutional excitement followed the operation, which yielded to appropriate treatment. On the 25th of February, the limb being still ununited, he was allowed to hobble about on crutches. This had no beneficial effect, and at the end of April, he was allowed to go home. In June his applied again for admittance, having been ill fed and reflected...
at home, the skin ones the old wound had given way and become ulcerated. Finding that he was willing to undergo a second operation, Mr. Borrow determined upon trying Döffer's method. On the 19th of July this was done, in the way I have mentioned before. The pegs were driven into the bone, flush with the periosteum. The fibula was left untouched. Very slight constitutional disturbance followed, about the 3rd day he complained of a sharp pain along the tibia, but this soon went away. The two lower incisors
healed by just intention. On Sept. 12, one of the upper pegs came away considerably eroded. On the 16th the second was then loose, it was removed, as well as a small piece of fractured bone. The other two pegs still remain. The limb during all this time has been well fixed in a back rest splint. Nov. 10. The wounds are all healed over. Nov. 29th. On examination today, union was found very incomplete; he was ordered to go into the country, with a splint fixing the broken parts. The knee to be bent at right angles to the leg & to wear a wooden leg. He is to return in a few weeks.