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A COURSE OF LECTURES ON SURGERY, DELIVERED IN THE MEDICAL SCHOOL OF CAMBRIDGE.

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LECTURE XII. FRACTURES.

Parts of the Skeleton most frequently broken; varieties of fractures; differences in the Skeleton at different periods of life; it may be broken by force of muscles.—Reunion of fractures corresponds with healing of soft parts; conversion of lymph into cartilage, the mode in which union with the old bone is effected; ossification of the cartilage; provisional and permanent callus; the former often absent; circumstances under which it is most abundant; absorption of provisional callus; objection to terms—provisional and permanent, and substitution of external, internal, and intermediate; modelling of the old bone in overlapping fractures; fractures into joints; compound fractures; diagnosis of fractures.—Treatment: splints should be applied at first; treatment of fractures in elderly persons, and of injuries generally.—Weakness of limb and stiffness of joints remaining after fracture.

Nearly all the bones of the skeleton are liable to be broken at any part, the long bones being more particularly so. The fracture most commonly takes place through the epiphyses in early years, through the shafts in middle age, and in the cancellous parts during the decline of life. The bones of the upper and lower extremities suffer about equally. In the lower extremities fracture occurs most frequently about the junction of the lower and middle-third of the leg, because the bones are there smaller in proportion to the weight they bear than in any other part of the skeleton. You may have observed, that if a man falls upon his feet fracture is more likely to occur in the tibia and fibula just above the ankle, than higher up or in the femur. In the upper extremities the radius and ulna near the wrist, and the clavicle about its middle, are more frequently broken than other bones.

The fracture generally runs quite through a bone in a transverse or oblique direction. In the flat bones, however, fissures frequently stop short of the edge of the bone; in the skull they sometimes run into the

foramina; at other times they commence and terminate in the substance of the bone. It now and then happens in children that the bones are bent, and is usually attended with incomplete fracture; it may be only a cracking or fissuring upon the convex and concave sides of the curve; or the bone may be broken half through, and a fissure may run upwards and downwards into the shaft from the fracture, just as a stick gives way when you try to break it by bending it across the knee. This bending, with more or less cracking, sometimes takes place in the flat bones; a blow on the skull of a child may cause a bending of the bone like the dent in a pewter pot; and I have known the same sort of thing, with fissuring of the bone occasioned in the cranium of an adult, by a wheel grazing against it. The broken ends of the bone may be more or less splintered and fragmented, detached, when the fracture is said to be comminuted, or there may be laceration of the soft parts around in the skin communicating with the fracture, which is then said to be compound.

The soft supple skeleton of the child is well protected by an ample subcutaneous cushion of fat, the consequence of which its breakages are not proportionate to its exposures. Nevertheless, it is so exposed to accident that it is very frequently broken, or its epiphyses are separated. During growth the earthy components of the bones are added in gradually increasing proportions, so that the structure becomes tougher and more resisting; and in the adult the same ingredients are intermixed with the animal matter in such quantities as to give the skeleton its great strength. This, however, is from various causes, and in the period at which it is most frequently broken; I have probably observed that the greater number of fractures received into the hospital are in the persons of middle-aged men. In the decline of life, the quantity of earthy matter being gradually on the increase, the bones become more brittle, so that a slight force will break them. M. Mercier has observed that the cancellous parts of the skeleton in old people undergo partial absorption in an interstitial manner, and are rendered more spongy and weaker by the thinning of their septa and the enlargement of their cells; the calibre of the medullary cavities is also increased, the expense of the internal spongy layers of the bone which almost disappear. The more compact tissue of the skeleton, on the contrary, such as the external hard parts of the shafts, become tougher and denser.

adults. This increasing difference between compact and cancellous parts of the skeleton, seems to be the result of a continuance of the changes progressing in early life, and leading to the absorption of the medullary and other cavities, accounts, in some measure, for the fact that fractures occur so frequently in the cancellous extremities of the long bones in elderly persons, and are comparatively rare in the shafts and harder parts. The contrast of the facility of different parts of the thigh bone to break at different periods of life is very remarkable; in the old man, fracture of the neck and upper end of the femur is an ordinary occurrence, the shaft being seldom broken, whereas in early life exactly the reverse is the

case. It is probable that, in addition to the changes just mentioned, the skeleton of the old man loses some of its resisting power in consequence of other variations from the adult type in its chemical composition; such as an alteration in the quality of its earthy matter and the nature of its animal constituents, in the quantity of organic substance contained in it, some of which seems to find its way into the structure of the bone, instead of being confined to the medullary tissue, &c. These variations, which all tend to weaken the bones, take place first and chiefly in the cancellous parts of the skeleton, and furnish a cause no less probable than that adduced by M. Mercier, for their comparative facility to fracture in the later periods of life.

The strength of the skeleton varies greatly in different persons. It is usually proportionate to the size of the muscles which act upon it, but sometimes the bone is so fragile as to give way under their contraction. Thus the humerus has been broken in lifting a tea-cup, and in throwing a ball. Even a sound bone may be broken by an inordinate contraction of the muscles connected with it. The fractures of the patella generally occur in this way, being caused by the sudden forcible action of the quadriceps femoris made in attempting to save the person from falling; and of one of you have probably heard Mr. Hammond relate a remarkable case which he witnessed where the femur was broken in its middle by the spasmodic contraction of the muscles of the thigh during the early stage of Asiatic cholera, whilst the patient was lying in bed.

The reunion of a broken bone takes place much in the same manner as the healing of the soft textures of the body; the new material, or lymph as it is called, effused between the divided parts being converted into an osseous structure, which corresponds in the laws of its formation and in its function with the cicatrix of the skin and other soft parts. Indeed it presents a nearer resemblance to the tissue it replaces than cicatrix commonly does. The difference between the reunion of the osseous and the soft parts of the frame consists chiefly in the greater length of time required for the completion of the former. That this difference should exist is no more than we might expect, from the dense resisting structure of the skeleton, its comparatively slow formation in the fœtus, and its remaining in an immature state for a considerable period after the other structures have acquired their peculiar characters.

Suppose a transverse fracture through the shaft of a long bone. It generally happens that the periosteum is torn through in the whole, or in part, of its circumference, and is further separated from the bone for a short distance above and below the fracture; the surrounding cellular tissue and muscular fibres are also more or less lacerated by the broken ends of the bone, or by the blow which caused the fracture. In the first instance blood is effused and coagulates between the broken and lacerated parts, extending for a short distance into the medullary cavity above and below the fracture, into the interval between the periosteum and the bone, and also to a greater or less extent among the surrounding soft parts, causing the bruised appearance which is often observed at a considerable distance from the fracture.

Soon the limb swells and becomes rather hot, tender, and painful; the blood is absorbed, the red particles first disappearing, and afterwards the fibrin. It may be that some of the latter remains, and becomes intermixed with the lymph effused in consequence of the first or reparative stage of inflammation which is now established. This lymph alone, or blended with a small quantity of the unabsorbed fibrin of the blood, to which it may possibly impart some of its own energy of organization, forms the basis of the uniting medium, is, in short, the lymph bed of organization, as the corresponding formation is called, when we speak of the healing of wounds in soft parts. It occupies the same, or nearly the same, position as the blood which had been first effused, but does not extend to so great a distance from the fracture. It encases the broken ends of the bone, runs into the medullary cavity, and is found among the surrounding lacerated soft parts, which are somewhat swollen, and are thus blended together by it as by one common bond of union. The soft parts and the bone are at this time more vascular than usual, so that a coloured injection thrown into the main artery of the limb may be seen to enter the vessels in the neighbourhood of the fracture more freely than in other situations. All the tissues are also a little softened, and the bone sharing in this change, and undergoing slight interstitial absorption, becomes somewhat soft and porous, as well as vascular. This alteration in the broken ends of the bone is very slight, and I should tell you that it is not admitted to exist by some anatomists, who have made experiments for the purpose of illustrating the process of re-union in fractures.

There is to be found, then, a few days after the injury, occupying the site of the fracture, a new material composed of lymph, of homogeneous structure, and forming one common uniting medium for all the several tissues which have been severed by the injury; we have now to consider the different transformations which this homogeneous substance undergoes to adapt it for the union of each of the several divided structures. The bone, periosteum, cellular and muscular tissues, are all to be re-united, and each exerts its particular influence upon the new lymph-bed of organization, so as to assimilate it in some measure to itself, and to adapt it for the fulfilment of its own functions, in a greater or less degree.

Vessels are first developed in the lymph, and become connected with the vessels of the periosteum and bone of the muscles and other surrounding soft parts, so that a circulatory current is established through it, and it presents the appearance of a reddish, soft, pulpy substance, occupying the position above described; the colour being now dependent not so much on the remaining globules of the blood first effused as on the red blood circulating in its vessels. Soon afterwards the lymph lying between the torn ends of the periosteum, becomes converted into a toughish cicatrix-like substance, which re-establishes the continuity of the membrane. This at least sometimes occurs, though not always quite in the manner I describe. The same thing takes place with regard to the surrounding soft parts; the muscular fibres are re-united, and the areolar tissue is re-produced in the cicatrix, so that the muscles and tendons become again separated from one another and from the periosteum, and resume their free play over the fracture. The healing of the soft parts is thus accomplished in two or three weeks after the accident.

A longer period is required for the completion of those changes, by which the new lymph substance is converted into a solid bond of union between the broken ends of the bones. Nevertheless, you must understand, that the change is of the same kind as that which I have just been describing to take place in the formation of cicatrix between the soft parts, and is due to the operation of similar forces. The lymph encasing the fracture, and walled in by the periosteum, is converted into bone in the same manner, and by assimilative agencies of the same kind, as those by which the lymph effused between the torn ends of the periosteum, and on its exterior, is transformed into fibrous and cellular tissue, cicatrix of muscle, and so on. It probably matters little, as regards the conversion of this lymph into bone, whence it has been derived, whether it has been furnished by the blood circulating in the vessels of the bone, the periosteum, or the surrounding parts. Its nature and properties are most likely the same from whichever of these sources it has been effused, and the changes it has now to undergo are the result of the assimilating influences of the tissues near which it lies regulating and modifying its own peculiar tendencies and qualities. You need not, therefore, perplex yourselves by attempts to solve the trite question, whether the new bone is formed by the vessels of the old bone, the periosteum, or the surrounding parts. Such a question is indeed scarcely consistent with those advanced views of physiology by which the vessels are seen to be, not the agents of nutrition, but simply the carriers of the materials for the work, and which attributes the formation of the tissues to the independent force of organization of the fibrin or lymph, modified by the assimilative influence of the immediately-adjacent structures. It is probable that lymph derived from any source may be converted into bone, provided it be situated within the range of those assimilative influences upon which ossification depends.

The formation of the bony substance which unites the fractured ends, or the callus, as it is called, takes

place in the following manner:—The soft reddish lymph surrounding and intervening between the broken extremities, extending into the medullary canal, and covered in by the periosteum, becomes, from the second to the third week, or thereabouts, converted into a firm toughish structure, resembling fibro-cartilage. The change by which this is effected commences in the lymph occupying the angle between the separated periosteum and the bone, and in the lymph effused into the medullary canal above and below the fracture; thence it proceeds upwards and downwards to the line of fracture, which is the part last affected by it. The broken ends of the bone are thus encased by an external ring, and joined by an internal plug of cartilage, which forms a tough, though flexible, bond of union sufficiently strong to prevent the displacement of the bone, but so yielding as to suffer it to bend at the fractured part. Subsequently, and more slowly, the lymph intervening between the ends of the outer compact walls of the shaft, becomes likewise converted into cartilage, and unites the ring on the outside, with the plug in the interior.

The process is curious by which the welding of this ring of cartilage with the hard structure of the bone is effected. It seems that, in consequence of the slight inflammatory or reparative process, the extremities of the bone become a little softened, and some interstitial absorption takes place on their surfaces, giving rise to a peculiar rough or worm-eaten appearance. Into the chinks and little holes thus made the new soft material is run, like molten metal, and solidifying there acquires very close and firm connection. You may generally see this condition of the surface of the bone by tearing off the new substance while it is in a soft state. In these two bones, both taken from old people, where union has failed for want of sufficient energy to effect the proper formation of callus, this change has taken place in the fractured extremities, which, in both instances, are rough, porous, and look as if they had been worm eaten.

When the formation of cartilage is completed, the ends of the bone are so firmly bound together, that no crepitus can be felt, although the limb bends at the broken part when the patient attempts to raise it from the bed; the free play of the muscles over the fracture is by this time restored, all surrounding swelling has subsided, and the patient is quite at ease.

The next change, commencing soon after the third week, consists in the conversion of this cartilaginous substance into bone. The process of ossification begins at the same point, and extends through the different parts of the uniting medium in the same order as the formation of cartilage had done. That is to say, the opaque nucleus of ossification is generally first perceived in the centre of the cartilage occupying the angles between the separated periosteum and the bone. From these points it radiates, reaching the hard wall of the shaft, extending into its crevices, and acquiring a firm connection with it. It travels upwards and downwards to the line of fracture, and crosses that line, so that an inosculation is established between the bony rings formed around each of the fractured ends; and they are converted into one broad

ring or clasp enclosing the fracture, firmly united as I just described to the broken portions above and below, and forming, therefore, a hard bond of connection between them. In like manner the ossification commencing in the plug at either end of the medullary tube, extends across the line of fracture, and forms here also a firm cement, joining the broken ends. The inosculation of bone across the line of fracture is the most difficult part of the process, requiring rest for its completion, and liable to be disturbed if a slight degree of movement be permitted between the fractured surfaces. We shall find, when considering the subject of ununited fracture, that this stage of the process is the one which most frequently fails to take place.

We have now, then, at about five or six weeks after the accident, the broken ends united by a bony ring on their outsides, and by a bony plug extending for a short distance into the medullary cavity, and obliterating it. The uniting medium thus formed becomes soon of sufficient firmness to bear the weight of the body, but the process of reparation is not yet completed, for the opposed edges of the exterior compact wall of the shaft are at present united only by cartilage, in consequence of the ossification taking place in this situation more slowly than in other parts, just as I told you that the conversion of lymph into cartilage takes place very tardily at the same point. By slow degrees the ossification extends to the cartilage lying between the extremities of the hard outer wall of the shaft, and the bony cement is here formed, uniting the edges of the shaft, and joining the external ring and the internal plug of callus firmly together. This ring and plug formed at an early period, to provide as it were for the reunion of the bone while the longer and more difficult part of the process is going on, has been termed by Dupuytren and other writers the provisional callus, in contradistinction to the callus which is last formed, and which is generally called permanent. It is well that some such provision takes place, for the consolidation of the extremities of the bone by the permanent callus is often many months, and may be even years, in progress.

The quantity of callus formed in the reunion of fractures varies a good deal. It is most abundant when the fracture is attended with much injury of surrounding parts, such as laceration and separation of the periosteum and muscles, or when, in consequence of continued movements or other cause, the first stage of inflammation is excited in a greater degree, or maintained for a longer period than usual. It takes place to the greatest extent after fractures in the lower animals, for in them the soft parts are generally much lacerated, the limb is subject to continual movements, and the ossifying processes are particularly active. It is from experiments made upon animals that the descriptions of the formation of callus, and particularly of the provisional callus, have been in great measure given. The several stages of the process of reunion which I have been describing are best witnessed in them, and the specimens on the table illustrating those stages are chiefly taken from animals. In many cases of fracture in the human subject, where the injury to the soft parts has been slight, and the limb kept at

rest, the formation of callus upon the exterior of the shaft, in other words, of the provisional callus, takes place to a very slight extent, so slight indeed, as scarcely to attract notice, and the union is then effected by the internal callus or plug, and by the intermediate or permanent callus, by which I mean the callus situated between the edges of the compact wall of the shaft. If this be so, you will naturally enquire whether the intermediate callus is in these cases so slow in its formation as under other circumstances it is described to be, and whether the reunion of the fracture is delayed for months, till it can be completed. I believe you will generally find, that when the periosteum has been but little torn or separated, and the external callus is consequently small, that the intermediate callus is more quickly formed. The comparatively rapid production of the intermediate or permanent callus, under such circumstances, is probably owing to its greater proximity to the periosteum; for an observation of the reparative processes in bones generally shows that the formation of new bony matter takes place with greatest facility in the neighbourhood of the periosteum, next in the vicinity of the spongy tissue of bones, and with greatest difficulty near the compact structure of the shafts of long bones when the periosteum has been removed from them. I think the formation of callus takes place more readily and abundantly in children than in adults, which probably depends upon the ossifying processes being more energetic in them, and the periosteum as well as the bone being more vascular.

The formation of the external or provisional callus is, therefore, by no means a constant or essential stage in the reunion of broken bones. Neither does it appear to expedite the cure, for, as I just said, in cases where the external callus is deficient, the intermediate is more quickly produced, and the firm union of the bones is scarcely delayed at all. This external callus seems to be related simply to the extent of laceration of the soft parts and the amount of inflammation consequent thereon, or occasioned by the movements to which the limb is afterwards subjected. These specimens show it to be produced on the shafts of bones more abundantly than upon their spongy extremities, which is probably accounted for by the periosteum being more easily separated, and the soft parts more commonly lacerated in the former situation than in the latter. If a fracture be occasioned by a force applied laterally, the periosteum is generally torn through on the one side even with the fracture, and may not be separated from the bone at all in that situation, whereas on the other side it is detached from the bone to a greater extent, though it may be very little torn or otherwise injured. Now, in such a case, as these specimens sufficiently illustrate, the external callus is formed chiefly between the detached periosteum and the bone; very little on the opposite side. Again, in fractures like this which I now show you, where there is much displacement, with overlapping, the external callus is formed, as you see, almost exclusively between the contiguous sides of the broken ends, the periosteum and adjacent soft structures being here more disturbed by the surfaces of the bone rubbing on one another than in other parts. In this situation it is formed

quickly and abundantly, and constituting the only bond of union may be called the permanent callus. Scarcely any callus is formed upon the other sides of the fracture, and sufficient only upon the extremities of the bone, which are widely separated from one another, to plug up the medullary canal.

I hope I have said enough respecting this external or provisional callus, to make you understand the real cause of its formation, and to explain to you that though it is not to be considered as a necessary part of the reparative process, being often wanting altogether, nevertheless that it does in some cases, to wit, in the overlapping specimens I just showed you, constitute the great and permanent—indeed the only bond of union between the fractured surfaces; and in other cases, where the periosteum has been much detached, it is produced in considerable quantities, and serves to hold the broken ends firmly together while the ossifying process is slowly pervading the cartilage which occupies the intermediate part of the fracture between the hard edges of the shaft.

The term provisional has been applied to this external callus, and I should say also to that which occupies the medullary canal, because, in course of time, when the intermediate or permanent callus has been fully formed, these two may undergo more or less complete removal by absorption. This is particularly true of the internal callus; and the continuity of the medullary canal is sometimes quite restored by its disappearance. It is true also in some measure of the external callus, for it does yield to a certain extent to this modelling process of absorption, and the proper external contour of the bone may be regained, as well as the continuity of its medullary tube restored. That this often takes place in a very imperfect manner only, is sufficiently shown by the knotty bulky masses of callus which surround some of these old fractures. The superfluous parts only of an external callus are absorbed, for when any portion of it is of advantage in contributing to the strength of the bone, it is permanent. The term provisional, expressing as it does, an occasional and unimportant, rather than an essential, feature of the callus, is likely to mislead you as to the real nature and object of this formation; I have, therefore, preferred the words external, intermediate, and internal, in the description of the different parts of the callus, because they relate merely to position, and cannot, therefore, involve any incorrect theories respecting the uses of the parts to which they are respectively meant to apply.

I should tell you that the torn ends of the periosteum do not always unite in the neat manner I have described so as to form a capsule, embracing and walling in the callus in the early stage of its formation. Sometimes they are blended with it so that they cannot be distinguished and separated from the cartilaginous matrix. At other times the callus projects considerably beyond the edges of the periosteum, and is formed among the tissues external to it. Sooner or later, however, the continuity of the periosteum is restored by the formation of new fibrous tissue over the callus.

We have now gone through the examination of the several stages of the process by which the firm reunion

of a broken bone is completed; but the work of reparation does not always stop here. It is not content simply with healing the breach, and reducing the callus to serviceable dimensions. During a long period of months, and even years, its efforts to restore the bone more and more nearly to a natural shape, are sometimes continued. Not only is the plug blocking up the medullary canal removed, but portions of the original bone which, in consequence of the displacement of parts, project into the canal, are also absorbed, and the tube is reopened through them. By the same process, when a tubular bone has been reunited, with much overlapping, so that the continuity of the medullary canal is quite lost, and each end of the bone is plugged with callus, it may be that a new line of tube is established through the contiguous walls of the shaft and the callus by which they are united, so that the medullary canal above the fracture is by this means reunited to that below it. In this specimen, for instance, the union of the overlapping fragments has been effected by the formation of callus between their opposed sides which has coalesced with both of them. The callus has a dense smooth exterior, like the wall of the bone, and spongy structure in its interior, resembling the medullary cavity. Moreover, the wall of the old bone has become porous about this region, so that the continuity of the medullary tube is in part restored through the centre of the callus, and through the opposed walls of the shaft. Of course this spongy condition of the interior of a callus uniting the sides of overlapping bones, is only found when the callus is of considerable thickness; and I do not wish you to suppose that I attach any especial importance to the continuity of a medullary tube, but have merely called your attention to these facts for the sake of pointing out to you the long continued efforts maintained after the reunion of a bone, for the purpose of regaining that shape which combines strength with lightness in the greatest degree, and of restoring the bone more nearly to an accordance with the original plan of its construction.

Portions of the shaft also which, in consequence of the displacement of parts, are thrown out of the line of the weight of the body, and are, therefore, useless, undergo atrophy, becoming light and porous, but they do not generally disappear altogether; indeed, I have often been surprised at the sharp angular fragments which remain for years projecting from an ill-set fracture.

If you have understood this general outline of the mode by which fractures of the shafts of long bones are repaired under ordinary circumstances, you will be able to make out for yourselves the different modifications that must be required in particular cases; for instance, when the fracture is comminuted or the surfaces displaced in various ways. Fractures of the flat bones, as the scapula, the cancellous bones, and the expanded ends of the long bones are reunited in the same manner; except that as I before told you there is not generally much external callus about the fracture of the cancellous bones, because the periosteum, in consequence of its close adhesion to them, is detached to a very slight extent or not at all. The cancellous texture, like the medullary cavity in the

shaft of a long bone remains preternaturally compact in the line of fracture for a long period after the injury, but ultimately resumes its natural condition.

When a fracture extends through the cancellous extremity of a bone and its cartilaginous covering into a joint, the injury is generally followed by some inflammation causing the effusion of serum and lymph into the articular cavity. The fissure in the cartilage becomes filled up and covered in by lymph, and, in course of time this lymph is converted into a tough fibrous structure firmly uniting the cartilage, and presenting a smooth surface towards the joint; but there is no formation of bone upon the articular surface. Stiffness of the joint is not to be feared from the projection of callus into it, so much as from the effects of inflammation; for besides the effusion of lymph which may occasion adhesion of the synovial surfaces, the inflammation consequent on fracture into a joint is sometimes followed by absorption or even ulceration of the cartilages.

The circumstances attending a fracture into a joint are not favourable to the reunion of the broken bones; for, in addition to the liability of the parts to be disturbed by movement, the effused products from which the callus should be formed become intermixed with synovia, and may fail to be ossified. Here are specimens of fracture into the elbow joint where this failure has occurred. The fractured bones are united only by fibrous tissue, and the joint is surrounded by nodules of bone corresponding to external callus, but they are united to one another and to the old bones only by fibrous tissue, so that if the specimen were macerated they would all be quite loose; and the articular cartilages are reduced to a fibrous shreddy state. In this specimen of fracture through the lower end of the tibia which has been macerated, you see that the fragments of the bone as well as those of the external callus are loose, though they were united by fibrous tissue sufficiently strong to admit of the man's walking upon the limb. The cartilages have also undergone the same change as in the elbow.

The reunion of a simple fracture taking place in the manner I have described corresponds exactly with the healing of the soft parts, by adhesive inflammation, the difference consisting only in the greater length of time required for the completion of the process. When the fracture is compound, the wound may heal up at once, and the case be reduced to the condition of a simple fracture, which is the most desirable result. Should this not take place, the blood and lymph first effused escape through the wound in a fluid state, and the reunion of the broken bone and of the soft parts, has to be accomplished by a secondary formation of lymph, which becomes converted into granulations. These granulations, springing from the ends of the bone, the periosteum and other structures inosculate across the line of fracture, and become transformed into a toughish fibro-cellular or fibro-cartilaginous structure, which ossifies much in the same manner as the corresponding substance in simple fractures; but the process is much more tedious, is attended with suppuration, and is liable to be interfered with by severe inflammation in the surrounding parts, by necrosis of

the ends of the bone, and a variety of circumstances. The formation of callus on the exterior of the bone, in its medullary cavity, and between the edges of its compact outer wall, may in these cases be sometimes observed to correspond with external, internal, and intermediate callus of simple fractures. Generally, however, the callus is produced in a very irregular manner, and very slowly. It long remains soft, crumbling when macerated, and by very slow degrees only does it attain that near resemblance to the structure and composition of true bone which the uniting medium of simple fractures is found to possess.

The diagnosis of fracture in the shaft of a long bone is easy enough. The altered contour of the limb, the unnatural flexure, and the circumstances attending the accident, render the feeling of crepitus, which may be occasioned by rubbing the broken ends upon one another, unnecessary. When the neighbourhood of a joint is the seat of injury, the diagnosis is more difficult, and will test your skill and knowledge of the anatomy of the part very closely. This is particularly true of injuries at or near the elbow, and of the fibula near the ankle. I would advise you to pay great attention to this department of practical surgery; not merely because your own reputation is likely to suffer by a mistake in cases of this sort, but because it is of much importance to the future utility of the patient's limb, that a correct diagnosis should be made at first. The requisite information to guide you in difficulties must be obtained by close observation of the skeleton, and diligence in the wards of the hospital. I can here only commend the subject to your careful attention.

The crepitus occasioned by the rubbing together of the broken surfaces is, when clearly felt, alone sufficient evidence of the nature of the injury, but some caution is required to enable you to appreciate correctly, even this simple means of diagnosis; for sometimes it cannot be felt, owing to the particular position of the surfaces, and at other times it is simulated by the sliding of tendons, or the rubbing of the articular cartilages upon one another, upon the blood, and upon the soft structures on the exterior of a joint, when dislocation has taken place.

The treatment of fractures is almost exclusively mechanical, our object being to reduce the fractured surfaces to their proper position, and to keep them there. That this is not always an easy matter is sufficiently shown by the various positions in which broken limbs are placed by different surgeons, and the various retentive means which have been recommended. I would advise you not to be biassed by any particular theories, or bound by any particular rules, but to place the limb in such position as you find disposes the fractured surfaces to fall into apposition most readily, and your first object should be to ascertain that position. If the broken bones do not fall readily into place with the limb lying one way, try another, and be not satisfied till you have found that which is most suitable. It is far better to rely upon the position of the limb for securing the correct adaptation of the fractured surfaces, than upon splints and bandages. You should endeavour to arrange all this when you first see the patient. It may happen,

however, that the spasmodic contraction of the muscles is so great that you cannot decide the position of the limb till a few days have elapsed, and the part has fallen into a more quiet state.

In fractures of the leg and thigh I generally try first the straight position, with the patient lying on his back, because I find that it suits the greater number of cases, and because I am certain that the patient is more easy and manageable in this posture than in any other. It answers more particularly well when the fracture is situated near the middle of the limb. If it be near one of the extremities of the femur or tibia, it is sometimes necessary to bend the limb for the purpose of relaxing the muscles attached in the immediate neighbourhood of the fracture, but even in these cases I have often found the advantage of substituting the straight for the flexed position. We use the double inclined plane, or Earle's bed, with benefit in some cases, as in fracture of the upper or lower end of the femur, but as a general rule the patient is less comfortable upon it than when lying on his back, with the long splint applied on the outside of the limb, and he is more liable to suffer swelling of the leg, and stiffness of the knee, which not unfrequently prove a source of greater and more tedious inconvenience than the fracture itself.

Having ascertained the position in which the broken bones fall together most readily, we next endeavour to secure their being kept at rest by the application of splints and bandages. The former, of course, should be fitted to the size and shape of the limb, and well padded with some soft material, so as to prevent injurious pressure. It is, I believe, the best practice to apply these at once, for by securing and supporting the limb they save the patient much pain, and they unquestionably exert a good deal of influence in keeping down the swelling and inflammation which is likely to follow an injury of this sort. If the limb be in the first instance laid loosely upon a pillow, and covered with cold lotion for two or three days, which is the practice of some surgeons, it almost invariably swells more, and is more painful, than if the moderate pressure of well padded splints be applied soon after the accident. This observation requires to be guarded by the hint that you ought to remove the bandages and splints if the part should happen to become more painful under their pressure, because the neglect of this precaution has sometimes been followed by considerable injury to the limb; indeed I have already related a case to you in which mortification supervened under such circumstances.

Much care is required in the management of fractures in elderly persons; for the confinement to bed, added to the shock of the accident, may be sufficient to depress their bodily powers beyond the possibility of rallying. They are shaken, enfeebled, become sallow, and die of exhaustion. You should take heed, therefore, not to reduce their diet too much, and watch for the symptoms of bed sores, so that you may catch the earliest intimation of their appearance, and place the patient upon a water-bed, or apply to the broken limb an immoveable apparatus, composed of egg-splints and starch bandages, or other similar

materials. The patient may then be allowed to get up and move about on crutches, without detriment to the fracture. By a little care, and the timely employment of such means, you may often save your patient's life in cases of this sort. The same remarks apply more or less to the ordinary treatment of fractures, even in adults, for though they generally do well under any circumstances, if the limb be kept quiet, yet some persons suffer much from the confinement to bed, become pale, weak, and low spirited, and the work of reparation drags heavily on unless the diet be improved, or the patient allowed to move about, with the limb supported in the way I have mentioned.

Indeed, in the treatment of other injuries which require the confinement of the patient, no less than in fractures, is it necessary to be watchful, especially with regard to persons who have passed the middle period of life, who have been in the habit of living freely, or have been much in the open air; for when the stimuli upon which they are accustomed to depend are discontinued, they soon begin to droop; perhaps they present the symptoms of delirium tremens, or they fail more gradually, and having little vigour to resist disease, and still less power to rally from it, they succumb under slight disturbing causes, which in their more healthy state would have produced no impression upon them. A slight exposure to cold causes inflammation of the lungs, which soon runs on to suppuration; or a little disorder of the stomach and bowels gives rise to fatal diarrhoea. I have repeatedly known stout, florid, robust-looking persons confined to bed and kept on low diet, in consequence of an injury, suffer in this way, who might probably have escaped had a more liberal diet been permitted, and the confinement within doors been less rigidly enforced. Sometimes they recover from the immediate effects of the injury, but are so shaken by the ordeal they have undergone, that they do not rally, and soon fall victims to some other attack.

The period when the fracture is united with sufficient firmness for the patient to leave his bed, varies a good deal. He may generally do so in from four to six weeks, but you should examine the part, and satisfy yourself as to its condition, before giving him permission to get up. The limb is generally so weak that he has no disposition to bear upon it for some time longer; and this weakness is not confined to the newly united bone, for the muscles participate in it, and the circulation through the limb is feebly conducted. The foot is blue, cold, and swells when it is hung down. The sores which may have been occasioned by the pressure of the splints, heal very slowly, and others are likely to be produced by slight causes. As the bone regains its strength, the muscles and the circulation generally resume their vigour; but they are sometimes very long in doing it. There was in the hospital some time ago a little child who did not recover the use of the limb for more than a year after a fracture of the thigh. She had been treated in the hospital. There was nothing remarkable in the case, and no reason to suspect any injury of the nerves. The bone also united in the usual manner. She, in course of time, got quite well, the cure being due rather to the kindly

efforts of nature than to any particular treatment. We likewise every now and then have a patient in whom œdema of a limb remains for a long time after the fracture is firmly united. The last imperfection which attracts attention, and this sometimes continues to give intimation of a weakened state of the limb for life, is a preternatural sensitiveness to atmospheric changes, which often amounts to pain. The patient is reminded of his former accident by uneasy sensations, or aching at the seat of the fracture during windy weather, or at the commencement of a thaw.

The joints in the neighbourhood of a broken bone often remain stiff for a considerable period, and the tendons are long in recovering the free play in their synovial sheaths. Some of these stiff joints which have been examined, were found to have undergone changes similar to those caused by inflammation; that is to say, the synovial surfaces were coated with lymph, united by adhesions, and, in a few instances, the articular cartilages were more or less extensively removed by absorption and ulceration. I do not mean to say that these changes always, or even commonly, take place, but it is well to be aware of their occurrence now and then, especially as they do not seem to be attended with the symptoms usually accompanying the inflammatory affections of joints. I do not know that you can facilitate the recovery of these joints by any other means than friction, bathing with warm water, active and passive movements of the limb, and the use of flannel.

A SUCCESSFUL

CASE OF CÆSAREAN SECTION, WITH REMARKS.

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(Read at the Anniversary Meeting of the Provincial Medical and Surgical Association, held at Worcester, August 1st, 1849.)

The subject of this case—Mary, wife of William Haigh—resides at Flats Fold, a mile from Ashton-under-Lyne, and about eight miles from Manchester. On my arrival, at half-past three o'clock p.m., I called upon Mr. Cluley, who accompanied me to the case, and with the greatest courtesy and candour, gave me as we passed along, the following particulars:—She had felt slight pains, according to the account of the friends, about a week, but Mr. Cluley thought that true parturient pains had only existed about three days, and which were so slight as not to require his interference. On this day, (Sunday, May 20th, 1849,) at nine o'clock, he was again called, and although the pains were still trifling, he made an examination per vaginam, but was unable to feel either the os uteri, or the presentation; he therefore had her taken out of bed and placed on the lap of a female friend, and again repeated his inquiry. The head of the infant was now felt, and the os uteri found dilated to the size of a half-crown piece. In this manner he unintentionally ruptured the mem-

branes. The pelvis, he mentioned, was considerably contracted. I found her lying on the right side. Pulse 120; tongue clean and moist; her countenance tranquil, but a little flushed. Her bowels had been freely and fully moved this morning; and she had also freely and duly urinated. She was helplessly fixed on her side, and when requested to turn, she remarked that she suffered very great pain when she made an attempt to do so, or was by another person turned on the back. The pelvis was very considerably altered from its natural shape: its sides were flatter; and the posterior division of the ilia, especially on the left side, projected backwards; and the upper portion of the sacrum and the lower lumbar vertebræ, had sunk in an inward and downward direction, so that a great concavity was perceived here. The uterus inclined rather to the right side, and stood considerably more forward than usual, although it had not assumed the retort form to the same degree as I have witnessed in former cases; its tissue felt soft and compressible. The fundus or upper division of the organ was fluctuant, and rounder in shape than it generally is after the discharge of the liquor amnii, which led me to conclude that a great portion of this fluid still remained. This opinion was corroborated when I attempted to ascertain the position of the infant through the abdominal parietes, for at the lower or cervical portion of the uterus, from whence it was presumed the fluid had escaped, the projections of its body could only be felt.

By a vaginal examination I found the lower aperture of the pelvis very considerably diminished by the close approximation of the rami of the ischia and pubes which nearly destroyed the arch, and by their jutting forward there remained only a narrow slit, which would not admit the point of the finger. In the transverse diameter, two fingers could only just be placed between the tubera ischii, the antero-posterior diameter was also much shortened by the coccyx and the lower part of the sacrum being considerably incurvated. This great diminution in the outlet rendered it difficult to measure the brim, so that it was necessary to carry the hand very far backwards to accomplish it. Its figure was tripartite, or composed of three divisions. This alteration in the brim was occasioned by the falling downwards and forwards of the upper part of the sacrum, and the lower lumbar vertebræ which inclined a little more to the left side, and by the body of the ossa pubis and ischii being forced backwards and inwards, and by the jutting forwards of the symphysis and rami of the pubis. The measurement of the widest part of the conjugate diameter, in the two lateral divisions, did not exceed an inch and a half; I could only place two fingers, one lying a little over the other. The anterior division was not more than half an inch in its widest part, as it would scarcely admit one finger edgewise. The length of this narrow opening is not relatively available in practice. In the transverse diameter of the brim I could just place three fingers, parallel with each other. The external genitals were free from tumefaction, and the vaginal lining was moist, and of a natural temperature. Whilst lying on her side I was unable to feel either the os uteri or the presenting part of the infant, but on placing her on her