CLINICAL LECTURE

THE SURGERY OF THE EPIPHYSES.

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GENTLEMEN,—In your experiences in the field of surgical practice, you will be called upon to traverse many thorny paths; and, I venture to predict, you will find few more thickly beset with difficulties than those which will tax your skill in the treatment of accidental injuries of and around the joints of children and young subjects.

You may have prepared yourselves by the most careful, painstaking, and accurate study of books; you may flatter yourselves that you have been close observers of all such injuries as have come under your observation, whether in hospital or in your more private experience; and yet, unless I am very greatly in error, you will, every now and then, be brought face to face with some such injury as will not only tax all your surgical acumen, all your anatomical knowledge, and all your experience, but concerning which you will feel, after all, that, both in diagnosis and in treatment, there are elements in the case about which you can be by no means either perfectly clear or happy.

I am sure I need hardly remind those of you who make good use of that most excellent institution, our Wednesday morning consultation, how often such cases are brought before us as a "staff," as a "court of decision," in which various opinions have been formed by as many people as have been consulted in the case before we see it, and in which even we, with all our large experience, are sometimes unable exactly to agree.

I am not speaking of *bonâ fide* "recognised" fractures and dislocations, such as are most minutely described in your lectures and in all your surgical text-books. These, I need not say, you ought, and no doubt will, recognise easily enough; but of certain cases in which the nature of the accident that has happened is uncertain and unascertainable, in which the symptoms and conditions present will fit in with no known description, which will, in some points, answer to the usual descriptions of a dislocation, in some to those of a fracture, and in some to those of both, and which yet, when all are grouped together, will present some inexplicable features, and will leave you doubtful what the real nature of the injury is after all.

If such a case as this be taken, as in a large number of instances they are, to a "bone-setter," it matters little, save to the sufferer, either what he thinks or what he does. If he succeed, in his rough and ready way, in rectifying the evil, it is well; and if he do not, and the patient be permanently crippled, it is rarely even reckoned against him as a want of success; but it may be—I have seen very painful instances in which it has been—very differently dealt with as regards the duly qualified surgeon. He has often been dragged into a court of law, and, under a charge of malpraxis, has had to bend under the weight of heavy penalties; whereas an unqualified practitioner is permitted to go scot-free, because, having done his best, and failed, the fault has been considered to lie, not so much with him who, according to his light, has done the best he could, as with those who were unwise enough to ask his advice in preference to that of a properly qualified practitioner. Of us as educated men, greater things are expected, and, provided only we are true to ourselves and to each other, it may safely be so.

Of the bones anatomically, the charlatan knows nothing, nor has he any real conception of the anatomical construction of the joints. In a rough and ready way, he knows perhaps their forms, and the movements of which they are capable, but of their physiological structure and bearings upon each other and on other structures he is ignorant; and most of all, is he ignorant of the special peculiarity by which the bones and joints of the young are adapted to the special conditions of their life.

I am not able, and I greatly regret that I am not, to show you the complete skeleton of a young subject. If I had one, I should point out that there exist in it certain differences from the skeleton of an adult, so plainly marked, that it would be impossible for the least observant student to pass them over without being compelled to take

note of them. Thus, if I show you—as I am able to do—side by side, the skull of an adult and the skull of a child, you may see at once what I mean. While in the adult the bones are all so firmly interlocked, and so completely united that, practically, they may be regarded as one bone, in that of the infant no two are permitted directly to touch each other; between each, a layer of unossified membrane or cartilage remains, in some places larger, in some less, but sufficient in every case to admit of some expansion and contraction under varying conditions, and to permit the rapid and easy growth of the various parts of the brain within. Let me remind you of the freedom with which the sinuses from the interior of the skull communicate with the veins upon the exterior, and how greatly more numerous are the points of communication between these two sets of vessels in the infantile than in the adult skull, and then let me ask you what reason you can see for this.

You know that, at birth, the head and upper extremities of a child are, so far as development is concerned, in a state of very decided advance upon that which has been attained by the pelvis and lower extremities; and you have only to reflect on the conditions of the foetal circulation to understand at once the explanation of the fact.

The head and upper extremities have, during their foetal life and growth, been supplied with pure arterial blood, direct from the placenta, while the pelvis and lower ones have had only the impure supply made up of half pure and half impure blood. Thus, while the parts and organs necessary for the maintenance of life from the moment of birth are, at the time of birth, capable of fulfilling their ultimate function already perfectly, those which are not then necessary remain undeveloped.

Except that they may grow, and be ready by the time they will become necessities, the lower limbs of an infant are but useless appendages; but it is not so with the medulla oblongata, and with the parts necessary to enable it to take the breast, to swallow and to digest its food, or to aerate and oxygenate its blood.

So, also, for many a month to come, during the period of unsteadiness and instability of gait, and of feeble muscular development, it is fundamentally necessary that the whole bony framework, and especially that of the head, should remain soft and pliable, and capable of yielding under blows and pressure to a degree that will be quite unnecessary in later life; and on this principle the whole skeleton of the child is built.

To those of you who have not already read it, I would earnestly recommend a thoughtful perusal of the little monograph on the development of the cranium which I hold in my hand—it is the work of an old friend who has gone to his rest, John Hilton—for I never remember to have read anything which gave me greater pleasure. As a physiological and philosophical exposition of the structure and growth of the skull, it is, in my opinion, unequalled; and it will be impossible for you to rise from the study, as he herein presents it, without advantage.

His account of the development of the sphenoid bone alone, of the manner in which, by its growth, provided for by many separate centres of epiphysary ossification, and by its position in the centre of the base of the skull, it is enabled, acting as a wedge, so to provide for the increasing size, and to give space for the growing lower maxilla, for the replacement of the twenty primary by the thirty-two permanent teeth, and for the widening and spreading out of the temporals by the adapted pressure of the condyles of the lower jaw, with the lateral expansion of the base, is an example of argument so simple and yet so perfect, that it will abundantly repay you for the expenditure of a large amount of both time and thought.

With one or two remarkable exceptions, there is not a bone in the frame that is perfected until long after birth, and the greater proportion of them remain in an unfinished condition till the full future stature of the subject has been attained.

I well remember, gentlemen, when I first studied the bones, and prided myself on having mastered all the intricacies of their outward forms, attachments, and relations, how agast I felt when I realised the fact that, even then, I knew almost nothing about them, and that I had yet to grapple with the mechanism of their interior structure, their organisation, and their mode of growth, and increase in length and breadth and strength. I found that I had yet to learn that never a bone was formed complete from the first, but that all alike were developed in segments, and thus I first became acquainted with the nature of the epiphyses.

I saw, and I saw with as much of admiration as of wonder, how the shafts and the ends of the bones were kept apart by, first, a thick, and, later on, a progressively thinning layer of cartilage, which, however, until the bone had reached its ultimate growth, never disappeared, but continued as the active growing portion of the bone, and yet en-

dowed it with a degree of flexibility and power of resistance to injury such as no other arrangement could have equalled.

Think for a moment of the activities of the periods of childhood and of youth, and compare them with the quiet strength of manhood, and with the feebleness and decrepitude of old age. What would be the condition of childhood if furnished with the rigid and inflexible bones of old age?

Note how the proximity of the epiphyses to the joints increases their power of movement and of flexion, and you will understand, in a moment, why the epiphyses exist, and then consider how they are placed.

Every long bone is developed, as you know, in separate pieces; a shaft, or central portion (diaphysis) and two extremities which consist of one or more pieces, according to circumstances, and are called the epiphyses. These separate elements, until the development and growth of the bone is completed, are, as you also know, never fused together. They are kept apart by a line of cartilage into which it seems to be the unceasing effort of the diaphysis to project itself; but as fast as the shaft succeeds in growing into the distal surface of the epiphysary cartilage, the cartilage itself continues to grow upon its proximal, or joint, surface.

Thus, in and around the joints of the young the life of the limbs reaches its point of highest activity, and is liable, in proportion to increased danger to harm, both physiologically and from injury and disease.

Let me explain what I mean by this, and take it as the first purely surgical point of this lecture. So long as the processes of normal growth proceed in a normal and healthy manner, the character of the bones and joints will be properly maintained; but, as in all other of the developments of nature, so in this, the natural process may prove erratic.

Normally, the epiphyses around a joint grow at the same rate, and in the same proportion, so that all parts of the joint, when completed, may fit accurately one into another, and may be so arranged as to move smoothly upon one another; but it has been shown by Professor Humphry that growth does not always proceed in this regular and orderly way; but that, now and then, the epiphysis of one component bone of a joint will outgrow the others, and, while wholly altering the outward appearance, will also greatly cripple the natural movements of the affected joint.

Suppose, for instance, a child of three or four years of age is brought to you with a complaint that something is amiss with its elbow. You find, on examining it carefully, that the natural range of flexion is considerably restricted. You find that the radius, while it will roll upon the ulna, does so stiffly and with difficulty, and, apparently, quite painlessly; in front of the outer condyle of the humerus, you find a prominence which ought not to exist there, and which, when you rotate the radius, rolls under your fingers, and is manifestly the head of the radius—rotating not as it should do on the capitulum, but upon the front of the outer condyle.

You, not unnaturally, suspect a dislocation, and you inquire what accident has happened? You are assured that no accident of any kind whatever has happened at all, and that no violence has been done to the limb; that it has always been an awkward joint ever since the child was born, and always a source of trouble and anxiety.

You may, not improperly, be suspicious that something is being kept back from you, intentionally or otherwise, and I think it not unlikely that you may end by believing that some unknown injury has been inflicted on the joint, by which the radius has been displaced.

Now, there is an injury of this kind which may be, and which often is, inflicted, quite unwittingly, on the joints of the arms of children; and which may, in such a case, have been overlooked. One or other epiphysis may have been loosened and displaced by improper traction upon the limb.

Even this may be denied, and again you may be reminded that the deformity has existed, as far as is known, from birth or soon after, and that no accident has ever been known to have occurred. In such a case, you cannot be too careful, and you cannot spend too much time over its investigation. Measure the two limbs carefully; measure the particular bones of the two limbs carefully; and if you find that the radius of the one side is decidedly and clearly longer than that of the other, do not forget the fact that it may be that the epiphysis of one may have grown unduly; and that the deformity may, so to speak, be a natural one, and had better be left untouched.

Nature may diminish the evil, while unsuccessful surgical interference can only make it worse, and may lead to discredit on your part. (See Humphry on Growth of Epiphyses, *Medico-Chirurgical Transactions*, vol. xv, p. 295.)

On the other hand, from early death, or injury to, or absence of an

epiphysis, one or other end of a long bone may fail to grow at all; and so the bone may remain in a rudimentary condition, and may thus present peculiarities of a totally different, but equally puzzling, kind.

Again, by unequal growth in parts of a bone, the whole may be more or less disfigured or rendered useless.

No commoner cases are found in our wards than cases of genu valgum and genu varum, and such like distortions of bones; and, though I do not assert that these abnormal conditions are wholly the result of abnormal epiphysary growth, they are sometimes, and in some measure, unquestionably the result of overgrowth, and sometimes of failure of epiphysary development; and the enormous number of osteotomies of one kind and another that are performed in this hospital, for the relief of such deformities, is proof by which the frequency of such abnormalities of growth is demonstrated.

The soft tissue, of which the line of junction between the epiphysis and the shaft of a bone is composed, is very liable to injury, and such injury to be followed by disease, which often assumes most serious proportions.

I dare say you have often seen a sight which, to me, is a very painful one, and one which invariably makes me shudder, namely, how an ignorant or thoughtless parent or nurse may be seen swinging a child of tender years freely round by its extended arms.

You cannot have failed to notice the ruthlessness with which a hurrying adult may often be seen dragging a weary child along, or lifting, or throwing it by an extended arm over the edge of a causeway or some such impediment, and little thinking of the terrible suffering they may be inflicting upon the child.

If such a child be brought to you a few days later, suffering with tenderness and swelling in the neighbourhood of the joints of the arms, and you inquire whether any accident has happened, of course you will be told there has not, and the frolicking or the dragging will have been wholly forgotten.

In the majority of instances, such a case will be presented to you as one of "rheumatism," and, if you be unwary, you may accept and act upon the supposition; but if the subject I am bringing before you to-day has impressed itself, as I would fain hope it will, upon your minds, your thoughts will fly at once to the line of epiphysal growth about the joints; you will remember that it is peculiarly prone to injury, and liable to inflame, and that the inflammation, if it be not speedily checked, is pretty sure to lead to suppuration, or ulceration, and may be followed, probably enough, by acute periostitis, osteomyelitis, and even, in some cases, by septo-pyæmia and death.

Even trifling injuries in the neighbourhood of joints have been known to produce all these consequences. My friend Mr. Macnamara, in his book on *Injuries and Diseases of the Bones and Joints*, mentions many such, and the subject is one which will abundantly repay you for any amount of thought and care you may devote to it.

Inflammation excited in this or other ways, as by cold, exposure to damp, to overstrain, or to other traumatic injury, is especially liable to lead to suppuration.

You will, without doubt, have noticed how very numerous the cases of hip-joint disease which come under the care of the surgeons of this institution are. For many years, we had been inclined to regard all these cases as instances of strumous disease, and of constitutional origin; but, of late years, noting how healthy the subjects of them were in other respects, and how entirely wanting they were in any other evidence to bear out the theory of strumous origin, we have come to look upon them as much more frequently traumatic in their initiation.

If you will consider for a moment or two how the activities of childhood are manifested in climbing, wrestling, playing, and in sports which necessarily involve frequent falls, rushes, and the like, and will bear in mind what I have been saying of the delicacy and tenderness of the lines of epiphysary junction, and of their proneness to inflammatory action, you will understand how this change of opinion has forced itself upon us.

A child whose health has previously been unimpeachable meets with an accident, not, perhaps, thought seriously of at the time, and which leads only to a few days of disablement and stiffness of some one or more joints—it may be of the hip, or of the knee, or of the ankle—and, after a little while, all seems, for a time, to get well again; but, after a few weeks, the joint begins to be painful again, becomes puffy or swollen, is the seat of a good deal of nocturnal pain, and, finally, becomes so manifestly the seat of disease that it is brought up for examination. It is found to be swollen, tender to manipulation, hot, and, if carefully examined, probably boggy places will be found about it; and, if an exploring needle be introduced into one of these, pus will be found to exude; if an incision be then made and a finger be introduced, or a probe, if a finger cannot, it will not unfrequently

be found that, at the bottom of the wound, bare bone will be detected; not necessarily dead bone, but bone from which the periosteum is ready to strip on the smallest provocation, and which, unless great care be taken of it, will certainly die, and that to an extent much greater than would, in the first instance, have seemed likely, but which, if kept rigidly at rest, freely and thoroughly drained and protected from the burrowing of matter under the periosteum, may, even yet, do well. The case may thus end as one of inflammation simply of the growing bone, and happy the subject in which it does so. But not unfrequently the portion of the shaft immediately separated from the epiphysis by the suppuration does eventually die, and must either be removed by the surgeon, or, by a long, painful, debilitating, and dangerous process, has to be extruded by nature.

Such partial necrosis, in the neighbourhood of an epiphysis, is not unfrequently seen in connection with the lower end of the femur; and I can call to mind many instances in which both I and my colleagues have been called upon to remove such under circumstances of great difficulty and danger. I have seen the popliteal artery and vein both cut across by such a sharp sequestrum in making its way to the surface, and I have been called upon to amputate the thigh under similar circumstances, and have lost my patient because the operation came too late to obviate the effects of preceding hæmorrhage. But the mischief may not stop short by the formation of a small sequestrum such as this; it rarely does so. Much more frequently it goes on to the destruction of the greater part, oftentimes of the whole, of the diaphysis of the bone.

If you have studied the subject carefully, you will have noted, not only how the ossifying fibres of the diaphysis project themselves into the linear spaces in the epiphysary cartilage into which its cells group themselves, but you will also have noticed the close intimacy with which the perichondrium of the one and the periosteum of the other are united, and you will be prepared to understand how, by "continuity of tissue," inflammation commencing in one will be propagated along the other.

In this way the entire periosteum of the shaft may become involved; matter is freely formed between the periosteum and the bone, and, destroying the connection between the two, and arresting the formation of new subperiosteal blastema, may cut off the life of the bone in its thickness, as well as at either end, and thus the entire shaft perishes. The mischief may, indeed, spread even more deeply than this; and, affecting not the periosteum only, may spread also into the medullary canal, may be propagated through the endosteum also, and may end in osteo-myelitis, pyæmia, and death.

Fortunately, this does not very frequently happen. In the great majority of instances, the shaft or part of it perishes, and, on the subsidence of the inflammatory process, the still living periosteum and endosteum resume their normal bone-forming function, and a new shaft is formed around the dead one, and is destined, eventually, efficiently to replace it.

It would be foreign to my present purpose to enter now into the further study of this process, and to advance to the subject of necrosis, but I desire to remind you how often you see young persons the subjects of this disease, and to point out how very frequently it may be traced to an attack of inflammation in the active growing ends of the bones, overlooked or too lightly regarded in its early stages.

How fortunate it is that the bones are supplied with their nourishment in sections, as I have thus shown you that they are, the ends through the epiphyses, while the shafts are in the main developed by subperiosteal growth, can hardly be overestimated. If it were not so, if it were not for the limiting influence of the epiphyses, we should rarely see the recoveries we now look for, almost with certainty, in the many cases of necrosis which come before us, but should have entire bones perishing, and coming away, to the sore detriment, and often entire loss, of utility in the limbs. In illustration of the truth of this proposition, let me show you this little preparation. It is a reminiscence of a most interesting case which, many years ago, I saw with Mr. Scattergood, and which made a very great impression on my mind, and, I believe, on his also; so great, at any rate, that we thought these bones worth preserving; and now, for your sakes, I am very glad we did preserve them. We were instructed by the coroner to make a *post mortem* examination of a child who had died after, and, as its parents asserted, in consequence of, vaccination. Our instructions were to make a most careful and searching examination, and to ascertain, if we could, whether any real connection could be traced between the vaccination and the death; and I need not say that we approached our task with a feeling of very grave responsibility. The most minute and painstaking examination disclosed no trace or evidence of anything having gone wrong in the arms; the wounds caused by the vaccination were perfectly and soundly healed; the areolar tissue

around the eschars was perfectly natural; but, when we came to examine the root of the neck, where some fulness and puffiness existed, we found both clavicles lying entirely loose in their periosteal coverings, and had simply to lift them out the entire and perfect bones you see.

You will perhaps remember that, in speaking of the growth and formation of the bones, I used this expression: "With one or two remarkable exceptions, there is not a bone in the frame which is perfected until long after birth." When I said this, I had the clavicle especially in my mind. This bone is very nearly as perfect as it ever will be, not only at birth, but long before, and is almost the only one devoid of epiphyses. Later on, at about the eighteenth or twentieth years, it develops a small one at its sternal end, but practically it may be considered to be perfect from birth.

Should it happen to be the subject of acute periostitis, from whatever cause arising, it would follow that, instead of the shaft only perishing, the whole bone would fall; and the instance I am laying before you is proof that it does so die in its entirety, from end to end.

I have a second case of the same occurrence, which, a year ago, was to be seen in the children's ward of this house. A little boy (Mark Brook), aged 7, was admitted on January 26th of last year. He had fallen from a cart on to his right shoulder. The parts about the right clavicle were bruised and swollen, and by January 30th were acutely inflamed. On the 31st, an abscess over the clavicle was incised, and the bone was found denuded for its whole length. The abscess was drained, and dressed antiseptically.

On February 14th, the clavicle was found lying apparently quite loose in the abscess-cavity, and was removed by dividing it into two parts at its middle, and lifting each part out after slight enlargement of previous incision.

On February 18th, the case was dressed, and the wound was found quite healed; and on the 19th the boy left the hospital.

By the kindness of Mr. Ward, to whom I am indebted for the above details, and who had preserved this bone, I am able to show it you to-day, and you may recognise the entire bone from end to end, as perfect as though it had been macerated for the formation of a skeleton.

What would have been the condition of the infant I have mentioned, in whose case both clavicles had perished, I have often wondered.

In the latter, in which only one bone was destroyed, we were all amazed to see how little its loss was felt. The movements of the arm were only more free, and very little weaker, apparently, than in the other; but what, when the full use and strength of the limb become necessary in after-life, its condition will be, I am, of course, unable to predict, as the subject is, even yet, only a child; but, seeing that the bone, devoid of epiphyses, is wholly developed by subperiosteal growth, and that the periosteum was not destroyed, I am inclined to hope that, before full growth is attained, some sort of useful substitute will be produced, which will be sufficient, at any rate, to support the arm upon the sternum.

Another class of cases sometimes, but more rarely, comes under our notice. Amongst our many cases of morbus coxæ, we now and then come upon such as, having resisted all treatment, and threatening to end in death, compel us to resort to excision, or even amputation.

On cutting into the joint, and turning out what should be the head of the femur, we find that the head has entirely disappeared, and a rough, eroded, worm-eaten-looking stump is all that remains; or it may be that, finding the neck of the bone in this condition, on introducing the finger into the acetabulum, we find a loose and similarly worm-eaten sequestrum there, which is manifestly the dead and separated original head of the bone.

Now, epiphysary cartilage, besides its proneness to take on inflammatory action as the result of local injury, is also very liable to ulceration; and in these cases I am inclined to think that ulceration, commencing on the joint side of the epiphysary cartilage, is the true explanation of this condition when we find it.

Experience has also shown us, gentlemen, and recent examples which have occurred in my own practice and in that of Mr. Atkinson remind me, that epiphysary growth may not only be abnormal in direction and in extent, but may be abnormal in nature also. We have both of us been called upon to amputate in cases of sarcomatous tumours affecting the bones, which, on careful after-examination, have been found to originate in the epiphysary cartilage. One case of mine was so characteristic an example that, by his earnest request, I forwarded the tumour to Mr. Macnamara, and this is his description of it.

"The head, or rather upper epiphysis of the fibula, has been trans-

formed into an oblong tumour as large as a goose's egg. The diaphysis of the fibula is hardly affected; at any rate, its elements, up to the extremity which impinges on the tumour, though worn down by pressure, are normal. The tumour is circumscribed, being enclosed in a capsule of dense connective tissue, which is lined by a layer of imperfectly formed bone. Within this capsule is a mass constituted of lamellæ composed of temporary cartilage, in which are seen attempts at the development of bone. The spaces between the lamellæ are filled with cells resembling those of a 'round-celled' sarcoma. I think there can be no question that this tumour has developed from the upper epiphysis of the fibula: in fact, it might be correctly described as an abnormal growth of that part of the bone. It contains elements very similar to those found in the embryonic condition of the bone, and certainly no structures or cells which are not to be seen in embryonic tissues."

This brings me, gentlemen, to the development of my subject, which, when the idea of selecting the "Surgery of the Epiphyses" as the title of this lecture, was that which I had chiefly in my mind—I mean, the relation of the epiphyses to dislocations and fractures.

I think it was the occurrence on several consecutive, or closely consecutive, Wednesday mornings, of one case after another, in which some difficulty had arisen as to the diagnosis and treatment of injuries of the elbow-joint, which first prompted the idea, and led me to remember the many occasions in my life in which similar difficulties had confronted me in my individual capacity, and when I had not the benefit of the aid and assistance which able colleagues here are so ready and willing at all times to give each other.

One such occurred to me while I was on the surgical staff of the dispensary; and it made all the greater impression on my mind, because of the mental attitude in which I found the parents of the child. A supposed simple dislocation backwards of the bones of the forearm at the elbow had been treated, in this institution, under the care of the late Mr. Teale, and had resulted in a considerable amount of deformity, with tolerably free movements of the joint, but accompanied by some permanent stiffness and locking.

Now, the mere fact of deformity remaining after the supposed reduction of a simple dislocation, put me on my guard, and led me to make a minute and careful examination of the parts; and I came to the conclusion, and did my best to explain to the parents, that the injury, so far from being a simple dislocation, had really been a dislocation accompanied by fracture through the epiphysis; that the remaining locking of the joint, in particular movements, and the deformity, depended, not on the consequences of the dislocation, but on those of the fracture by which it had been accompanied; and that, though the joint had not been restored to its original condition of perfection, the result was, for such an injury, a very excellent one, and one with which they had every reason to be content. But they were not, and took legal advice upon the subject, and threatened an action at law against Mr. Teale, and were, finally, only dissuaded from proceeding with it by the assurance of my then partner, the late Mr. Garlick, that they had no ground for any such action, and could not possibly hope to succeed in sustaining it.

You may ask, and not unreasonably, how you are to protect yourselves under similar circumstances, and I would reply by one or two very simple suggestions.

1. You should never consider your knowledge of the bones to be perfect, until you have made the anatomy of the epiphyses as thorough as that of every other point in connection with them; remembering or providing yourselves with the means of reference to the age at which they become individually consolidated to the rest of the bones.

2. In undertaking to deal with a dislocation, or with a fracture in the immediate neighbourhood of a joint, especially in children and young subjects, you should never forget to recall their existence and their anatomy to mind, or fail to remember the relations they bear to the bones under consideration, and especially the exact anatomical relation which each epiphysis bears, not only to the joint of which it forms a part, but also to the diaphysis of the bone, of which it is a component element.

3. If you have reason to believe or think that their implication will affect the ultimate result of the case, you should make a point of carefully explaining, from the very first, your doubt or fear to those who place it under your care, and to disclaim all responsibility for future conditions which it may be impossible, by the greatest care and with the highest skill, to prevent.

4. Lastly, a consultation with a brother practitioner is an unfailing safeguard.

You will, I think, find each one of these suggestions to be of intrinsic value; for if, in dealing with an injured joint, you know that

the consolidation of the bones which enter into its composition is completed, you may at once dismiss all idea of epiphysary complication; while, on the other hand, if it be not, you have to consider the accident in a double light; first, as such an injury would affect a fully developed joint; and, secondly, as it would, or might, affect it with such complication as may have been introduced by the presence of the epiphyses.

Thus, supposing an injury to have happened to the elbow-joint, and to consist, as you think, of a simple dislocation backwards of the bones of the forearm, the age of the patient may make a very material difference as to the opinion you form concerning it. If he be over twenty, you will probably find but little difficulty either in reducing the dislocation, or in retaining the bones *in situ* after reduction; but it may be very much otherwise with a patient of more tender age. With such an one, you may find matters equally simple, and easily dealt with; but you may, on the other hand, find that neither is the reduction so easy as usual, nor, reduction having been effected, that you are able to retain the bones in their normal position, but that they tend persistently to revert to the abnormal one. In your efforts to effect the reduction, you may possibly have felt something like "crepitus," and then more minute and careful examination is not unlikely to reveal the fact that the lower epiphysis of the humerus has been separated from the shaft, and that the whole joint, consisting of the epiphysis with the bones of the forearm attached to it, has been drawn up behind the stump of the diaphysis.

Now think, for a moment, how widely different must the after-treatment in these two cases be. In the former, simple rest for a while in the restored position is all that will be required; whereas, in the second, without firm retentive apparatus, the displacement will be almost certain to recur, and, unless the fracture be kept up for a length of time sufficient to command reunion of the parts, may end in failure, disappointment, and disgrace.

This is only one of instances almost innumerable that I could quote as having passed under my own observation; and, in young subjects, there is scarcely a dislocation or a fracture in the neighbourhood of a joint that may not be thus complicated, nor one in which, if you be wise men and good surgeons, you will fail to suspect and search for some such complication. And if the advice, that you should master the ages at which the epiphysal growth of the individual bones is completed, is sound, I am no less certain of the equal soundness of my second recommendation, namely, that you should study with equal care the exact relationship that exists between the epiphyses and the shafts of the bones.

Unless you be equally clear on this point, too, you may be led into many otherwise avoidable mistakes. Let me illustrate this position by reference to the upper epiphysis of the humerus.

For a long time, and by many surgeons of the highest eminence, it was believed and was taught that the tuberosities belonged to the shaft, whereas, in truth, they are included in the epiphyses, and, in case of its separation, belong, with the head of the bone, to the upper, and not to the lower fragment (see R. W. Smith, *BRITISH MEDICAL JOURNAL*, August 17th, 1867, p. 123); and this, when you come to study the attachment of the muscles, and the displacement which, in case of separation, those muscles will cause, is a matter of very great practical importance, and may lead you to treatment which may be correct or otherwise in proportion to the extent and correctness of your anatomical knowledge.

You have, indeed, only to turn to the writings of Dr. R. W. Smith, Professor of Surgery in the University of Dublin; to those of Mr. Jonathan Hutchinson, of London (see *Clinical Lectures on Rare Forms of Fractures and Dislocations*, *Medical Times and Gazette*, 1866, vol. i.); or to the now wonderfully improved text-books that are in all your hands, to see that the advice I am giving you is sound.

Let me quote to you a passage from a most brilliant "Address in Surgery" which I was privileged, a few years ago, to hear delivered by Professor Smith himself to the members of the British Medical Association. Speaking on this subject, he says: "When the surgeon is called upon for his opinion respecting the nature of injuries occurring in the vicinity of the larger joints in early life, he will find a knowledge of the anatomy of the epiphyses of the greatest importance."

Erroneous ideas as to the parts included in the epiphyses, and the shafts respectively, has in many instances led to error in diagnosis, and to maltreatment of individual cases, which might have been avoided had more accurate and perfect knowledge been available at the time the diagnosis was made.

On this point, Professor Smith writes thus: "I have elsewhere pointed out the error committed by Vidal, and other writers, in supposing that the tuberosities of the humerus belonged to the shaft of the bone, and shall now endeavour to show that a similar error has

been committed with respect to the lower epiphysis of the humerus; and that those authors who have written upon the subject of injuries of the elbow-joint have confounded with each other fractures above the condyles and disjunction of the epiphyses, from ignorance of the anatomical fact that the lower epiphysis of the humerus does not include the condyles, which belong entirely to the shaft of the bone; the epiphysis includes nothing but the trochlea and capitulum. The fundamental mistake of placing fracture through the line of the epiphysis among supracondylar fractures (as has been done by Malgaigne, Vidal de Cassis, Dupuytren, and others) has involved the equally glaring error of distinguishing these two injuries from luxation of both bones backwards by the same diagnostic sign—namely, the loss of the normal relation of the olecranon process to the condyles of the humerus."

Fortunately, gentlemen, it is not often that we are able to demonstrate what has actually taken place in accidents such as these. In the majority of instances, they are simple fractures or dislocations, and the true condition of the parts is hidden beneath unbroken skin; but, now and then, it happens, either because the injury forms part only of some more serious accident, or because it leads to consequences which are, happily, uncommon and necessitate amputation, we are enabled to do so. When we are, the illustration becomes doubly valuable, and I am able to show you one such to-day.

In this preparation, we have one such which implicated the lower extremity of the femur. The patient was a youth aged about 17, who had been caught in some machinery, and had been violently twisted round. A serious injury to the knee was the result, and he was admitted into the infirmary under the care of the late Mr. Samuel Smith. A fracture very low down in the shaft of the femur was diagnosed, and it was found impossible to rectify the displacement which had taken place. The accident had occurred a few days before my election as surgeon to this institution, and the case was amongst the first handed over to my care by Mr. Smith. The preparation has, therefore, an especial value, on that account, in my eyes, and is one to which I have often had occasion to refer.

When I took the case over, I found gangrene setting in in the foot and leg; and, by Mr. Smith's advice, I amputated the limb above the fracture, and here we see exactly what had happened. The lower epiphysis of the femur had been torn from its connection with the shaft, and had remained, with but little displacement, almost *in situ*. The shaft had been driven down into the popliteal space, and had so stretched the vessels, both artery and vein, and the popliteal nerve, that gangrene was inevitable; and it was clear to demonstration that no power would have sufficed to replace the fragments in position.

Once since I have seen an almost identical case in the hands of Mr. Atkinson, and a knowledge of what had taken place in this case of mine enabled us from the first to form a correct diagnosis concerning it. In that case, Mr. Atkinson endeavoured, in the first instance, to excise the displaced epiphysis, but without success; and was compelled, as I had been, to resort to amputation, which, as in my case, also proved successful, so far as the life of the patient was concerned.

Cases such as these cannot fail to make a profound impression on the minds of those who have charge of them; and as, when the first occurred to me, I registered a mental vow that I would never forget how important a part the epiphyses may play in such accidents, so now, after twenty years of further experience, I stand here thankful for the lesson I then learned, and feeling it to be my bounden duty to urge upon you the observance, through life, of a similar course of vigilance and care.

CUCAINE.

By A. PERCY SMITH, F.C.S., F.I.C., Rugby.

If the demand for cucaïne increase to any great extent, it is not unreasonable to suppose that some adulterated specimens may find their way into the market; although, no doubt, since few practitioners will purchase the drug from any but well known houses, the risk of adulteration is small.

Owing to the liberality of Herr Merck, of Darmstadt and London, who placed a small quantity at my disposal, I have been enabled to apply a few tests to this alkaloid, with the object of ascertaining its properties, so that I might be able to detect the presence of adulteration, if such should arise.

Since the quantity I had was but small, I directed my attention chiefly to optical tests, or the study of the crystals deposited from various solvents, viewed under the microscope by the aid of polarised light, as I have found this method very useful, and of great assistance

to chemical tests. There are a few alkaloids, such as strychnine, cantharidine, and salicine, which can at once be identified by this means alone. In other cases, where the crystalline form is not distinctive, it serves as a means for determining its purity, since admixture frequently alters the manner of crystallising (for example, quinine-sulphate pure, and mixed with cinchonine-sulphate), or else prevents it altogether, nothing being left, on evaporation of the solvent, but a gummy mass.

Cucaïne-hydrochlorate is soluble in chloroform, ether, and alcohol. From chloroform it does not crystallise (owing, probably, to rapidity of evaporation); from ether and alcohol it does; but best from the latter medium. The method of procedure is to place a fragment of the alkaloid in a watch-glass, add some alcohol and a few drops of ether, and allow it to evaporate spontaneously in a warm room. In a few hours, feathery rosettes of crystals may be seen on the glass. Strong heat, and consequently rapid evaporation, are fatal to crystallisation.

Crystals of cucaïne-hydrochlorate, crystallised from alcohol, seen by polarised light. Magnified 24 diameters.

If the crystalline film be very thin, it will appear of a bluish-white under polarised light; but usually the crystals are thick enough to produce prismatic colours.

The advantage of using polarised light may not be obvious in this case, since the crystals are visible without its aid. This is not always the case; for instance, strychnine deposited from chloroform may be completely invisible without this illumination.

So far, it must be confessed that there is nothing peculiar about the crystals of hydrochlorate of cucaïne, sufficient to distinguish them from other alkaloids with monoclinic crystals in a radial form; yet, where we are dealing with a known substance, any alteration or modification of a recognised crystalline form would naturally suggest the presence of an impurity; but it yet remains to be seen if adulterated specimens are to be obtained, and what effect such adulteration will have.

One peculiarity about the crystals is that the hydrochlorate and the free base both assume the same form, which is rather unusual.

The other tests which I was able to apply are:

Sulphuric acid No colouration.

„ + Potash-Bichromate „

Nitric acid „

Shosphomolybdic acid Yellowish-white precipitate, soluble in ammonia and in hot nitric acid.

Phosphotungstic acid Gelatinous white precipitate, soluble in ammonia.

THE ACTION OF CUCAINE ON THE NASAL MUCOUS MEMBRANE.

By E. CRESSWELL BABER, M.B.Lond.,

Surgeon to the Brighton and Sussex Throat and Ear Dispensary.

It may be interesting to know that I have been able to confirm Bosworth's important observation ("A New Therapeutic Use of Cucaïne," *New York Medical Record*, November 15th, 1884, abstract in *Centralblatt für Laryngologie*, vol. i, No. 8), in which, however, he appears to have been forestalled by Jellinek (compare Professor B. Fränkel, *Monatsschrift für Ohrenheilkunde*, etc., vol. xix, No. 1, p. 18), to the effect that cucaïne not only acts as a local anæsthetic to the nasal mucous membrane, but also has the power of contracting