ON SUBCUTANEOUS OSTEOTOMY.*

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THE operation of "subcutaneous osteotomy" has, no doubt, been selected as one of the special subjects to be brought forward before the Surgical Section of this Association at its present meeting, in consequence of the rapidity with which it has been adopted in this and other countries within the last few years; and I cannot but regret that the discussion is not opened by a greater and abler authority than myself. The operation is, however, one that belongs to a large class of subcutaneous operations which have been grouped and described under the head of "subcutaneous surgery", a subject which has especially engaged my attention for many years, and to which I have made some contributions; so that I have the less hesitation in offering to this meeting some observations to which experience has led me, and a few suggestions as to the points which would, I think, be discussed with the greatest advantage, and upon which the experience of the members now present might be given to the profession.

There are a considerable number of surgical operations which owe their immunity from inflammation and suppuration, and consequently their freedom from danger, to the fact of their being performed in such a manner as effectually to exclude the admission of air. As familiar examples of this class, I need only refer to subcutaneous tenotomy; the subcutaneous operation for the removal of loose cartilages from the knee-joint; the subcutaneous operations for varicose veins, naevi, ununited fracture, the radical cure of hernia, the obliteration of depressed cicatrices, the division of strictures; and the operation of subcutaneous osteotomy, which forms the subject of the present discussion.

All these operations on the subcutaneous principle are performed by puncture instead of external incision; the puncture being made by a very narrow-bladed knife, for most purposes only an eighth or from that to a quarter of an inch in breadth, at a little distance from the structure to be divided; so that an indirect subcutaneous tract exists between the external puncture and the structure to be divided. These operations are all governed in their mode of performance, the pathology of the reparative process, and their terminations, by the same general law, described, more especially by M. Guérin, as the law of subcutaneous surgery.

It must not, however, be assumed that the exclusion of air offers an absolute immunity from inflammation under all circumstances, and independently of the amount of damage done to the deeply seated structures, or of the constitutional condition of the patient.

When the subcutaneous method is applied to the performance of operations of unusual magnitude, such as division of the neck of the thigh-bone, division of the shaft of the femur or humerus, it would be unreasonable to expect the uniformity in favourable results which follows the subcutaneous division of tendons, because the conditions upon which the safety of the subcutaneous method depends cannot all be with certainty fulfilled. In these large operations, the air may be effectually excluded: but the injury to the deeply seated structures may be excessive, either from cutting or laceration by the instruments used, or the force employed. Deep-seated suppuration, therefore, will occasionally follow such operations, although the rarity of this result has astonished every surgeon who has practised them. As we recognise the importance of the amount of injury inflicted on the deeply seated structures, in addition to the exclusion of air, it will be obvious that much will depend upon the mode of performing the operation, as well as upon the skill of the operator; and the conditions which must coexist to render the subcutaneous operations free from inflammation and suppuration may be stated to be as follows.

1. That the knife used be of small size, generally from an eighth to a quarter of an inch in breadth, and very little exceeding this in the largest subcutaneous operation, in which the saw or chisel is used, in osteotomy.

2. That care be taken to make an indirect, instead of a direct, track between the cutaneous puncture and the deep structures divided, whether tendon or bone. This may be accomplished by shifting the cutaneous puncture before completing the division of the deeper structures.

3. That care be taken to preserve this track by pressure, which the operator can make with the finger or fingers of his left hand, whenever a second instrument has to be introduced, as in dividing the posterior tibial tendon when a blunt-pointed knife is passed deeply behind the

tendon after the withdrawal of the sharp-pointed tenotome; and in all cases of subcutaneous osteotomy, whether the bone be divided by the saw or by the chisel.

4. That the wound be immediately closed on the withdrawal of the knife or other instrument, and a compress and bandage applied, so as to continue the pressure over the seat of operation, and prevent the effusion of blood under the skin, or amongst the divided structures.

5. That the operation be performed quickly and neatly, with decision rather than force, and with as little disturbance to the soft parts as possible.

6. That perfect quiescence to the part be insured for three or four days, and the dressing remain undisturbed.

When all these conditions are strictly observed, it matters little whether muscles, tendons, ligaments, or bones are divided, or even whether the large joints of the body are opened. There is no better established fact in surgical practice than that subcutaneous wounds seldom inflame or suppurate when the above conditions are fulfilled.

Hunter, in 1784, made the exposure or non-exposure of wounds to the air the basis of his classification of wounds and injuries, and observes: "The injuries of the first division, in which the parts do not communicate externally, seldom inflame; while those of the second commonly both inflame and suppurate."

Although the principle upon which subcutaneous surgery is based was so well known to Hunter, and appreciated by him, he did not, so far as we are aware, ever apply it to practice; but in the numerous experiments he performed on animals, for the purpose of investigating the reparative process in tendons, Hunter divided some tendons subcutaneously, introducing "a couching needle under the skin"; and others he divided by open wound, for the sake of comparing the differences in the reparative process.

The operation which led the way to subcutaneous surgery, forming a starting-point from which it has gradually been developed, is that of subcutaneous tenotomy, first suggested and performed by Delpech in the year 1816; but, the first and only case recorded by him not being very successful, the operation seems to have remained dormant until 1831, when it was revived, and the method of performing it improved, by Stromeyer, whose name is now always associated with the operation. From this date, it was rapidly adopted by the German, French, and English surgeons; and other subcutaneous operations were gradually introduced.

The interest taken in this class of operations was greatly increased in the year 1841, when M. Jules Guérin published his treatise on what he described as "the subcutaneous method"; and it is undoubtedly to M. Guérin that we owe the first attempt to bring together in one group the facts observed in subcutaneous injuries, and subcutaneous operations; and, generalising from these facts, to show that, for the immunity from inflammation which they enjoy and the perfection of the reparative process, such wounds especially depend upon the same general law. Although I refuse to admit M. Guérin's claim to originality in the discovery of the subcutaneous law, which is purely Hunterian, there can be no doubt that for its development and surgical application we are principally indebted to the labours of M. Guérin.

Subcutaneous osteotomy seems to have been a late development in the series of subcutaneous operations; and for this we are also indebted to a distinguished German surgeon, Professor Langenbeck, who in the Schleswig-Holstein war of 1848 first introduced the use of a small straight pointed saw for the section of bones, passing it through the narrow opening in the upper arm in bullet-wounds, without further disturbing the soft parts; and in this way he removed exposed portions of bone. After the introduction of this saw, Langenbeck remarks that the idea of subcutaneous section of bones dawned upon him.

In his *clinique*, in the winter of 1852, Langenbeck performed subcutaneous osteotomy for ankylosis of the hip-joint, and also in a case of bony ankylosis of the knee-joint; and in 1854, when his observations on this subject were published, other cases in which he had operated for rachitic deformity of the legs were added. Langenbeck used a drill a quarter of an inch in diameter, placed in a brad very similar in its use and construction to that employed by cabinet-makers. After perforating the bone with this, through a small cutaneous incision, he introduced his narrow sharp-pointed saw, an eighth of an inch wide at the point, and four inches long; and with this the bone was sawn through subcutaneously until the shell or compact tissue was reached. The operation was then completed by breaking the remaining portion of bone, and the limb straightened. Suppuration, lasting from four to fourteen days, occurred in some cases.

Langenbeck's conclusions on the operation are:

"1. Bones can be cut subcutaneously like tendons, muscles, &c.

"2. Bones should only be partially cut subcutaneously, the partial section being preferable to the complete division.

* Read in the Section of Surgery at the Annual Meeting of the British Medical Association in Cork, August 1879.

"3. Healing of subcutaneous section of bone will not take place as in simple fracture, for the reason that the drill and saw produce some powder, which acts like a foreign body, and therefore some suppuration will take place.

"Subcutaneous section is indicated in deformity of bones and bony ankylosis, and where we cannot rupture, the bones being too solid."

The conclusion of Langenbeck with regard to the sawdust, I need hardly say, is not borne out by our recent experience, as we find that, in a very large proportion of cases, no suppuration whatever occurs; the subcutaneous puncture healing by the first intention, and the case proceeding as favourably as one of tenotomy.

In Germany, Meyer, Wernher, and other surgeons, adopted the operation, with some modification as to the instruments used, the chain-saw and a kind of trephine being employed.

Passing from Germany to America, Professor Gross of Philadelphia, in his admirable *System of Surgery*, reviews all the various surgical operations which have been adopted in cases of bony ankylosis, with the view either of obtaining motion or merely straightening the limb. After describing the large operations by open wound for ankylosis at the hip-joint adopted by Dr. J. Rhea Barton in 1826, and for the knee-joint in 1835, and the modification of this operation by Professor Sayre in 1862, Professor Gross observes: "In 1844, Dr. Gurdon Buck of New York, in a case of complete synostosis of the knee, with the limb at a right angle, so modified and extended the procedure of Dr. Barton as to remove the condyles of the femur, the head of the tibia, and the patella, in a wedge-shaped piece, thereby bringing the leg almost in a straight position."* This operation might certainly be classed with excision of the knee-joint.

The first subcutaneous operation for bony ankylosis of the knee-joint mentioned by Professor Gross in the historical sketch which he has given of osteotomy for ankylosis by open wound, and the subcutaneous method, is that performed on the knee-joint by that distinguished American surgeon, "Professor Pancoast, at the Clinic of the Jefferson Medical College in the winter of 1859, the patient being a youth on whom extension had previously been tried in vain. It consisted in perforating, with a stout gimlet, the femur subcutaneously, through a single opening, at half a dozen points, just above the knee, and then forcibly breaking the bone.....A large abscess formed at the seat of fracture, but with this exception, the case progressed favourably, and the boy made a good recovery."

Professor Gross then states that "an operation similar to the above was performed by Professor Brainard in 1860, upon a man twenty-three years of age; but in this case the femur was divided through its condyles by means of a perforator. The patient recovered with a good limb. In a second case, one of false ankylosis of the knee, the patella was detached subcutaneously from the femur and tibia, and excellent motion of the joint obtained."

Professor Gross himself quickly adopted the subcutaneous method, and at page 1,093 observes: "In 1861, I extended these subcutaneous operations to perforation of the joint itself, with disruption of the osseous adhesions between the bones entering into its composition. The instrument with which the operation is conducted, exhibited in fig. 548, consists of a shaft of well-tempered steel, four inches and a half in length, the point of which is one-sixth of an inch in breadth, and presents on each side an oblique groove with cutting edges, so that it acts as a gouge as well as a drill. This is fitted into a firm handle, its proximal extremity being large, smooth, and rounded, so as to rest comfortably in the palm of the hand. In some instances, the bony connections are so firm as to resist the action of the drill, in which event a narrow, sharp-pointed chisel may be substituted for it." This appears to have been the first case in which the chisel was used in America, and Professor Gross further observes: "This operation has been done successfully in six instances (*i.e.*, up to the year 1872), four having occurred in my own practice. In two of the latter, preliminary division of the hamstring tendons was demanded, and in all, firm bony union was procured."

The history of subcutaneous osteotomy by American surgeons is interesting, and shows how quickly they adopted an operation of German origin, an operation which afterwards slowly travelled into England.

The first operation of subcutaneous osteotomy in England was, I believe, performed in 1868 by Mr. L. Stromeier Little, the son of the distinguished physician, Dr. Little, who introduced subcutaneous tenotomy into England in the year 1837, having been himself operated upon by Stromeier in Hanover in 1836.

The case upon which Mr. Little operated, on November 11th, 1868,

was one of bony ankylosis of the right knee-joint, with the leg flexed at a right angle, occurring in a girl aged 14 years, the result of strumous disease. An incision, the third of an inch long, was made on the outer side of the joint, and "a strong carpenter's chisel rather less than a quarter of an inch wide was inserted into the wound, and driven with a mallet through the united bones in several directions". The limb was readily straightened, and lint, with bandage and splint, applied. The case progressed very favourably, the wound being nearly healed on the sixth day; and in three weeks she walked on crutches, and in five weeks without crutches.*

In this class of cases, it seems to me that the chisel, as employed by Mr. Little, is to be preferred, either to the short subcutaneous saw, which I use, at the hip-joint for ankylosis, in the knee-joint for genu valgum, and in all subcutaneous divisions of the shafts of the bones,—or to the method of drilling through the ankylosis, and then dividing the bone by Langenbeck's long pointed saw.

In the following year, a further impulse was given to subcutaneous osteotomy in this country by the operation which I performed of dividing subcutaneously the neck of the thigh-bone within the capsular ligament, with a small saw rather more than a quarter of an inch in width, and with a cutting edge an inch and a half in length, at the end of a blunt shank three inches in length. This saw was passed through the track made by an enlarged tenotomy-knife a quarter of an inch in width. The operation was performed on December 1st, 1869, on a man aged 24, a case of bony ankylosis of rheumatic origin seven years previously; the thigh was flexed upon the pelvis at a right angle, and abducted.

I entered the tenotomy-knife a little above the top of the great trochanter, and, carrying it straight down to the neck of the thigh-bone, divided the muscles and opened the capsular ligament freely. Withdrawing the knife, I carried the small saw along the track made—preserving this by pressure of the fingers of the left hand—straight down to the bone, and sawed through it from before backwards. The section was accomplished in five minutes. No hæmorrhage occurred; and a compress of lint with plaster and bandage was applied. The limb at once moved freely in all directions; but, before it could be straightened, the tendons of the abductor and rectus muscles had to be divided. No inflammation whatever followed; no swelling or redness of the skin, or any deep suppuration; only a few drops of pus escaped from the granulations at the orifice, which did not close by the first intention, or possibly from the track. Three weeks after the operation, he began to walk on crutches; and by swinging the leg about, as well as applying weight extension at night, I endeavoured to preserve motion; but this was gradually lost, and bony ankylosis in the straight position resulted. The man was enabled to follow his occupation, and now keeps a small general shop at Bath, where he was exhibited to the Surgical Section of this Association last year.

The decennial period which has now very nearly elapsed since the performance of this operation has been fruitful in the suggestions of other operations for subcutaneous osteotomy, and also for osteotomy with open wound under Lister's antiseptic method. The operation on the hip-joint has been adopted freely by surgeons in this country, and as freely by our enterprising brethren in America; it is now an established operation in surgery, and if the cases in which it is performed be carefully selected, and the operation executed with the requisite dexterity, its reputation will be maintained. In a paper read at the Royal Medical and Chirurgical Society, October 10th, 1876, I recorded twenty-two cases in which the operation had been performed. Cases of a rheumatic or pyæmic origin are the most favourable, because in these affections there is no loss of bone-structure, and the head and neck preserve their integrity; but in the so-called strumous class—unfortunately much the largest—there is generally more or less destruction of the head of the bone, and other alterations in the anatomical relations of the joint; only the most favourable of this class should, therefore, be selected; but for the remaining cases in which my operation is not applicable, Mr. Gant's operation will be found to succeed. Mr. Gant proposed to divide the shaft of the femur subcutaneously, just below the small trochanter, using instruments similar to those employed by myself; but the saw had a longer cutting edge and a thinner blade; the width the same. Mr. Gant performed this operation December 10th, 1872, on a boy aged 6, who had ankylosis of the hip-joint, with extreme malposition of the limb upwards and inwards. Primary union of the wound occurred, and firm union of the bone with the limb in a straight position, giving an useful leg.

Mr. Gant has repeated this operation in several cases, and I have also performed it several times. In the same way, I have divided the shaft of the femur in the lower third; and the shaft of the humerus, a little above the elbow-joint, in two cases, for bony ankylosis in a straight

* *A System of Surgery*, by Samuel D. Gross, M.D., LL.D., D.C.L.Oxon. Fifth edition, vol. 1, p. 1092-94. Philadelphia: 1872.

* *Med.-Chir. Trans.*, vol. 54, p. 247. Longman, 1871.

position. In all the cases, the wound closed by the first intention, without any inflammation, swelling, or redness occurring. The local disturbance seemed to be no greater than in an ordinary tenotomy case.

The largest and boldest operation of subcutaneous osteotomy is that first performed by Dr. A. Ogston of Aberdeen, who applied the principle which I had adopted in the hip-joint to the cure of genu valgum, and used the same instruments, but with Lister's antiseptic precautions, which I have never adopted, as it has always seemed to me that we might absolutely rely upon the protective influence of the subcutaneous law. Dr. Ogston introduced the subcutaneous saw into the healthy knee-joint, through the track made by the enlarged tenotome, or subcutaneous knife, and then splitting the lower end of the femur detached the inner condyle, which in these cases is considered to be in an hypertrophical condition—at any rate, there is no doubt as to its relatively increased length. This operation was successfully performed by Dr. Ogston on May 17th, 1876, and an account of it was published in the *Edinburgh Medical Journal*. It has been repeated by many surgeons, both at home and abroad, with great success, and has already become an established operation in surgery. The testimony in favour of this operation by many surgeons is so ample and satisfactory, that it must be regarded as one of the greatest triumphs in subcutaneous osteotomy.

Other surgeons have preferred the use of the chisel, which was most successfully employed by the late Mr. Maunder, whose sudden and melancholy death has deprived the profession of one who had contributed much to surgery in its various branches, and had especially interested himself in subcutaneous osteotomy.

The use of the chisel in detaching the inner condyle, as it is said without opening the knee-joint, has been adopted by Mr. Reeves, and with considerable success.

Osteotomy, with Lister's antiseptic method, for genu valgum, has been very successfully adopted by Professor Macewen of Glasgow; and the operation which he performs is a section, or partial section, of the lower end of the femur with a chisel, without opening the knee-joint.

Professor Lister himself adopts the open-wound, with a free external incision, from one to two inches in length, and then uses the chisel on Macewen's plan. The compound fracture thus made and subsequently treated on the antiseptic method heals, as a general rule, without inflammation or suppuration. The favourable progress of such cases I have recently watched in Professor Lister's practice, but time alone can determine what percentage of unfavourable cases may occur.

In the discussion to which I hope this paper will give rise, I would suggest the following points as some of the greatest practical interest, on which we should like to obtain the opinion, and the result of the experience, of the members present, viz.:

1. The method of performing the operation of subcutaneous osteotomy, and the instruments to be employed, viz., whether the saw, chisel, or drill;
2. The selection of cases in reference to their pathology; the joint involved; and the instruments to be used;
3. The relative merits of subcutaneous osteotomy, without any antiseptic precautions; and osteotomy by open-wound under Lister's antiseptic method.

SUBCUTANEOUS OSTEOTOMY BELOW THE TROCHANTERS.*

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THE results of hip-joint disease, in a large number of cases, have recently suggested questions relative to their treatment, of greater practical interest than with regard to the prior management of the disease itself. When, in the course of that condition known as scrofulous disease of the hip-joint, the treatment by rest and extension has failed to preserve the integrity of the articulation, or to result in fibrous ankylosis, excision may be resorted to for the removal of the disorganised articular surfaces in order to obtain a fibrous or movable union, and thus an useful limb. But there are cases not a few, where this result is not accomplished by the favourable course of the disease under treatment, or even by the operative interference of excision. The union, at first fibrous, becomes ossific, and, if the patient be at liberty, more or less considerable malposition gradually takes place; the limb being raised to an angle with the pelvis, so as to be useless for standing

or walking. A similar condition is witnessed as the result of chronic rheumatic arthritis; but here the ankylosis is often attended with an exuberant deposit of nodular and hard bone around the neck of the femur.

Under these circumstances, various operations of osteotomy have been devised, having in view the substitution of a fibrous ankylosis, or the formation of a new and movable joint, and thus also to bring down the limb to the position requisite for use. I may refer to the operations originally proposed and performed by Dr. Rhea Barton in 1826, and by Dr. Lewis A. Sayre in 1862. Both these procedures were intertrochanteric—osteotomy between the trochanters; and the latter was an excision of a transverse plate of bone in that situation. Both also were effected by more or less extensive incisions in the integuments.

Subcutaneous section, in the neck of the femur, is the well known operation of Mr. William Adams; first performed by him in 1869, and since practised with considerable success by himself and by other surgeons. This mode of osteotomy has the advantage of an operation governed by the general principles of subcutaneous surgery; and the situation of section, approaching nearest to the centre of motion, is the most desirable for the formation of a movable joint, thus to allow the freest movements of the limb. Accordingly, Adams's operation should always be selected, in appropriate pathological conditions, and when practicable. But there are exceptional classes of cases where this operation is impracticable, or, if eligible, would fail in its result. To these cases I would now direct the attention of the Association.

Firstly, when, in consequence of continued disease of the hip-joint, the head of the femur has disappeared, leaving only a stunted nodule of bone, representing the neck above the trochanters; in such case, the operation of section in the femoral neck cannot be performed, there being no neck to divide. This advanced degree of destruction may be ascertained by careful measurement of the femur compared with the other. Even when supratrochanteric section is practicable, the state of the neck may render this operation abortive. The seat of operation will be in an almost carious portion of bone, which is unfit to yield a fibrous union; or, possibly, atrophy or necrosis of the upper portion of the neck may ensue, by cutting off the vascular supply from bone already devitalised.

Secondly; another class of cases inappropriate for Adams's operation is when, the ankylosis having resulted from rheumatic arthritis, there is an exuberant deposit of new bone, forming hard nodules or spicula around the femoral neck, itself entire. The thickening and induration existing will resist any justifiable attempt to divide the bone in this situation.

In both these conditions of the hip, the operation of osteotomy may be transferred to below the trochanters; and with this additional advantage, that, the section lying below the small trochanter, the conjoint psoas and iliacus muscles will be set free, and thus the malposition of the limb effectually overcome. For these reasons, pathological and physiological, I originally devised what may be termed the infratrochanteric operation of osteotomy, as an alternative procedure to Adams's operation above the trochanters. My first operation below the trochanters was performed in the year 1872 (see *Lancet*, December); and the instruments used were a stout tenotomy-knife and a fine saw. These are the only instruments I have since employed; but the late Mr. Maunder preferred Volckmann's chisel, the operation being the same, only performed with a different instrument to divide the bone. His first case was in July 1875.

In the most recent case under my care, the condition may be taken as typical of the class wherein, owing to absence of the femoral neck from advanced disease, coupled with immovable ankylosis and extreme malposition of the limb, osteotomy below the trochanters may be practised with the most successful results. The leading particulars are thus reported by Mr. Atkinson, senior resident medical officer at the Royal Free Hospital.

C. K., aged 14, came to the hospital on April 30th, 1878, to see if anything could be done to alleviate the lameness, resulting from old hip-disease on the right side. When standing with the support of a crutch, the tips of the toes on that side just touched the ground, and the limb was dependent so far, only from great anterior curvature of the spine in the dorsal region; for when this lordosis was removed by raising the leg, the thigh formed a right angle with the trunk. The hip-joint had become firmly ankylosed, so that the pelvis moved with the movements of the femur, as though the two were one bone. To conclude the examination, it was found, by careful measurement of the femur, that, shortening having taken place to the extent of two inches, there could be no neck for section in that situation. Mr. Gant performed his operation of subcutaneous section below the trochanters, exactly as described in his *Surgery*; and as usual, without any antiseptic precautions. Following the principle of tenotomy, the puncture-

* Read in the Section of Surgery at the Annual Meeting of the British Medical Association in Cork, August 1879.