ON
FORCIBLE EXTENSION AND RUPTURE
OF THE UNITING MEDIUM
OF PARTIALLY
ANKYLOSED SURFACES.

BY
BERNARD E. BRODHURST,
ASSISTANT-SURGEON TO THE ROYAL ORTHOPÆDIC HOSPITAL.

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RESECTION of the articular extremities of bones is said to be among the greatest triumphs of modern surgery ; and when it is performed under certain restrictions, and as a substitute for a more formidable operation, it may doubtless claim to be so considered. But the excision of articular surfaces is at present of so frequent occurrence, and is undertaken not solely as a substitute for amputation, but is performed where amputation would never be thought of, that I beg to call the attention of the Society to the forcible rupture of partially ankylosed surfaces in cases where active disease has subsided, the operation being both less hazardous and more efficient than resection. For the sake of illustration, I have selected three cases of partial anky-

losis of the knee, in which the uniting medium was ruptured and the use of the limb restored; cases entirely analagous to three other cases, in which I have lately witnessed resection of the articular surfaces, so that, without absolute comparison, I might present to the Society cases in every respect similar to others in which resection has been performed. I have also added four cases of partial ankylosis of the hip-joint, in which rupture of the uniting medium was successfully performed, as well as a single case of partial ankylosis of the elbow. The mode of treatment usually adopted for the removal of contraction and partial ankylosis is either gradual extension after the division of tendons, or extension without the division of tendons when these are not so tense as to interfere with the extending process. In all cases of partial ankylosis, some advantage may be derived from gradual extension; that is to say, the amount of contraction may, in all cases, be somewhat diminished by gradual extension; and where the adhesions are soft, extension thus employed may be sufficient entirely to overcome contraction. But there remains a large number of instances in which gradual extension is wholly insufficient to overcome contraction.

The advantage of a partial restoration of the articular surfaces, or of partially overcoming contraction, leaving the limb in an imperfect state of extension and with no available motion of the joint, is inconsiderable and oftentimes questionable. I will endeavour to show that, where the adhesions constituting partial ankylosis, cannot be overcome by gradual extension, they may with safety be ruptured by forcible flexion and extension of the limb.

Dieffenbach was the first who had recourse to subcutaneous sections of tendons and fasciæ and forcible rupture of adhesions between articular surfaces. He ruptured the adhesions immediately after having divided the tendons, whilst consequently the wounds were open. Not only were these wounds made to gape, but they became starting points for extensive lacerations of the integument. Some of his operations were followed by violent inflammation and exten-

sive suppuration, which compelled him to have recourse to amputation ; and some were followed by fatal results.

Louvrier, desiring to remove contractions, and overcome partial ankylosis without wounding the skin (thus to retain the comparatively innocent character of subcutaneous injuries), invented a machine with which he hoped to effect this purpose. His first five operations were successful ; but subsequently, in Paris, in 1839, some of his operations were attended with fatal results. In one instance, the integuments of the popliteal fossa were ruptured, and the flexor muscles of the leg were lacerated ; suppuration ensued and death. In a second case the popliteal artery was ruptured ; and in a third instance the femur was fractured, both of which cases terminated fatally. .

In 1841, Auguste Bérard made his report relative to the forcible rupture of ankyloses, to the Academy of Medicine ; and this mode of treatment was in consequence abandoned in Paris. But Palasciano (of Naples) again drew attention to the subject, and advocated this mode of treatment so successfully, in 1847, that he found many followers, as Bonnet, Langenbeck, and others. Also at this time, the inhalation of ether enabled these violent operations to be performed without exciting excruciating pain, such as former operators were unable to avoid. Now, manual force was alone employed, and found to be sufficient to overcome contractions and ankyloses, flexion and extension being made without instrumental aid. But Palasciano further recommended the section of the triceps extensor cruris, as well as the tendon of the biceps ; after which, forcible flexion and extension were to be instituted to break down the adhesions.

In 1850, Langenbeck recommended the forcible rupture of adhesions after division of the tense fasciæ ; and he taught that it was alone necessary to divide the fasciæ, for that, under the influence of chloroform, the muscles became so sufficiently relaxed that section of their tendons was unnecessary.

Buehring, in Berlin, also adopted the same mode of

treatment. But this was also found to be liable to accidents of a serious nature, namely, to dislocations. The connecting bands were indeed ruptured on flexing and extending the limb; but the head of the bone was then not unfrequently drawn away from the articulation through the action of the more powerful muscles, especially when a tendency to dislocation existed.

Such, then, are the modes of treatment which have been hitherto employed to overcome contractions and partially ankylosed surfaces.

Before I relate the cases which I have now to bring before the Society, I will, in a few words, explain the treatment which I have adopted.

In the foregoing recital it will be observed that the errors in the various modes of treatment were, the open wound of Dieffenbach; the immoderate force employed by Louvrier; and the extension without division of tendons, as practised by Langenbeck and others. My aim has been to gain the desired results without exposing the patient to what I deem to be errors of treatment. I have, therefore, commenced by dividing subcutaneously those tendons which were likely to interfere with the extending process; the limb was then bandaged and reunion was promoted. When the punctures had healed, namely, from the sixth to the eighth day, the patient was placed under the influence of chloroform, and the adhesions were ruptured by flexing and again extending the limb.

Rupture of the adhesions was effected in the following manner. Having grasped the thigh immediately above the knee firmly with both hands, an assistant would grasp the leg above the ankle, and forcibly flex the leg upon the thigh, and again extend the limb; and these movements of flexion and extension were repeated until the adhesions were entirely broken through. Having command of the femur, I could at will increase or diminish the power in the hands of my assistant by raising or depressing the knee, as the tension of the skin might be great or otherwise.

The limb, after being fully extended, was bandaged, it was then placed in a trough-splint, and was subsequently again flexed almost to the same angle as before the operation. In the course of two or three days gradual extension was commenced and continued until the normal degree of extension was obtained. After extension was complete, passive motion of the joint was induced, the patient being under the influence of chloroform; and motion was continued daily, or at intervals of two or three days, until such power of motion as was possible was gained.

CASE 1.—J. N—, æt. 14, of healthy appearance, dark complexion, and a spare habit of body, was attacked when five years of age, on recovery from scarlatina, with inflammation about the knee-joint, which resulted in abscess. The knee became contracted, as I found it, nearly at a right angle, so that the toes remained raised some inches above the ground. The skin around the joint was covered with cicatrices, subluxation of the tibia backwards existed, and the leg was much atrophied. There was very slight (scarcely appreciable) motion at the knee-joint.

July, 1855.—I divided the tendons of the biceps, the semitendinosus, and the semimembranosus muscles, all of which were very tense; and when the punctures had healed, chloroform was administered by Dr. Snow, and, with the assistance of Dr. Dick, I ruptured the old fibrous adhesions which interfered with the motions of the joint.

Flexion and extension were made in the manner already described, when the adhesions yielded suddenly with a tearing sensation. The skin was bound by adhesions to the ligamentum patellæ and to the tibia below this point, and in consequence the tension of the skin became very considerable on flexing the limb. I, therefore, determined not to endeavour to further overcome the subluxation at this time, but to trust to a very complete apparatus which had been constructed by Mr. Bigg for this purpose. The limb was bandaged and placed in this apparatus; it was then flexed, and the head of the tibia was gradually raised to its

normal position. At the same time the limb was extended gradually; and flexion and extension were made alternately, without removing the limb from the apparatus, during four weeks. Passive motion, by means of pulleys, was then commenced, the thigh being supported on a portion of a double inclined plane, and the head of the tibia by an elastic pad. The subluxation was entirely removed, and there remained considerable power of flexion and extension of the limb. During four months these movements of the limb were continued, at the end of which time he could walk about the house without support. During eight years he had only been able to walk with the aid of a crutch; but now this support was unnecessary, except when he left the house. He left London in October, and in December he had thrown aside his crutch, and was able during this month to carry a gun for some hours on a Scotch moor, which experiment he repeated two or three times during the month, and happily without any untoward result.

CASE 2.—Mrs. W—, æt. 42, was attacked, after the birth of her last child, namely, in 1846, with phlegmasia dolens; abscesses formed around the knee-joint, and inflammatory retraction of the flexor muscles of the leg and of the fasciæ about the joint took place, adhesions were also formed, constituting angular false ankylosis, together with subluxation of the tibia backwards.

February, 1856.—The knee was bent at a right angle; the toes were raised eight inches from the ground; numerous cicatrices were situated about the knee-joint; the flexor muscles of the leg were very tensely retracted; there was just perceptible motion at the knee-joint. The patient had worn during several years a shoe, which supplied the deficient length of the limb, and enabled her to move about with a crutch. This shoe, however, had held the foot permanently extended, and had thus occasioned retraction of the muscles of the calf of the leg, or talipes equinus. With the assistance of Mr. Robinson, I divided the tendons of the biceps and of the semimembranosus and semitendinosus

muscles, as well as the portions of fascia which were most thickened. When the punctures had healed, I endeavoured to make gradual extension, but soon discovered that the adhesions were too dense to yield to such force as I could apply gradually; so, having administered chloroform, I proceeded to rupture the adhesions by forcible flexion and extension of the limb.

The adhesions yielded gradually with a tearing sensation, and motion was then increased until the limb could be perfectly extended. The subluxation was at the same time entirely removed. The limb was then bandaged and placed in a trough-splint, having a rack and pinion-joint corresponding to the knee. Having been well secured in this splint, the limb was again flexed to about half the extent of its former degree of flexion.

Considerable pain was experienced an hour after the operation, to allay which an opiate was administered, cold was applied to the knee, and the extension of the limb was again slightly diminished.

Acute pain was never complained of after this time; no swelling of the knee occurred, neither was there a blush of inflammation. Extension was carried on gradually until the limb was again fully extended. Passive motion was then commenced; at first, very slight movements could alone be borne, and these were subsequently increased until a tolerable range of motion was gained.

Later, the tendo Achillis was divided, and the sole of the foot was ultimately brought into contact with the ground; so that the patient was able to walk firmly. There was no shortening of the limb; and, although voluntary motion was only in part restored, the patient could move about comfortably, and without her crutch. The treatment occupied five months.

CASE 3.—M. B—, æt. 17, June, 1856, had suffered twelve months previously from rheumatic inflammation of the knee-joint; abscess resulted; a flexed position of the knee was assumed; retraction of the flexor muscles of the

leg followed, and immobility of the joint, in this flexed position. The limb was bent at a right angle, and was somewhat atrophied; the hamstring muscles, and especially the biceps, were tense; slight subluxation of the tibia backwards, and false ankylosis with the least perceptible motion of the knee-joint existed.

The patient was a healthy-looking and robust girl; she could only move about with crutches, and seldom left the house.

With the assistance of Mr. Robinson, I divided the tendons of the biceps, the semitendinosus and the semimembranosus muscles; and when the punctures had healed, chloroform having been inhaled, I flexed and extended the leg upon the thigh until motion was perfectly free, extension of the limb was complete, and subluxation was overcome. The adhesions yielded on the application of moderate force with a snap, and subsequently with a tearing sensation. The limb was bandaged, and placed in the extended position in a trough-splint; and having been well secured, it was again flexed to nearly its former position, by means of the cogged wheel situated against the knee.

No pain, except on motion, was felt, and there was scarcely tenderness about the joint. Cold was applied, and at night an opiate was given. The first night the patient was restless, and awoke in pain; this pain, however, soon subsided on the application of cold, and never recurred. On the fourth day, extension of the limb was commenced, it was carried gradually to its full extent, and was complete during the third week. Passive motion was then instituted, and in the course of some few days the articulation could be moved with considerable freedom and without pain. At the end of two months the patient could walk about her room, bearing her weight on the limb, and slightly using the joint. Improvement went on slowly after this time, and much rigidity about the articulation remained, yet considerable motion of the knee was obtained. In the following November, namely, five months after the operation, the patient could walk some steps without support, and without pain in the knee. The limb was daily gaining strength.

CASE 4.—E. B., æt. 8. When she was five years of age was attacked with rheumatic inflammation of the hip-joint, after sitting on a cold, damp seat; abscess formed, connected with the joint, and a fistulous opening remained; the thigh became flexed upon the pelvis, and to such an extent that the heel was raised one foot and a half from the ground, and adhesions formed preventing the motions of the joint.

On grasping the thigh and the pelvis firmly, in order to endeavour to produce motion, it was evident that ankylosis was not complete, but that the adhesions were fibrous. There was just perceptible motion of the limb on making a very careful examination. These adhesions were ruptured, August, 1854, by suddenly flexing and again slightly extending the thigh; and muscular contraction was subsequently overcome by gradual extension of the limb. During this period, and whilst extension was being accomplished, passive motion was made from time to time, and the head of the femur was moved in the acetabulum. Before extension was complete, the fistulous opening had closed. At length muscular contraction was entirely overcome; passive motion was then employed, and gradually increased, until the normal range of motion was gained. Some pain was induced by the first attempts at passive motion; but this lasted scarcely longer than the time during which motion was employed, and after some few days, pain was no longer experienced.

In the course of three months, the child had the power to flex and extend the limb partially and slowly, and this power increased rapidly. Five months later she could walk about without pain or fatigue, using a stick for support. There was shortening of the limb to the extent of half an inch, which deficiency required to be supplied by a thick sole to the boot.

Nearly twelve months after I first saw my patient, namely, in July, 1855, her father wrote to me that she usually walked three or four miles in the course of the day, without other support than a stick. And, moreover, he

added that in the immediate neighbourhood of the house she no longer used her stick.

Before coming to London, she had only walked with crutches. Her figure was stunted, and her health was extremely delicate.

At Christmas, 1855, the child had grown much, and was robust and active; and the motion of the hip was scarcely less than was that of the sound limb.

CASE 5.—L. S., æt. 13, March, 1856, of a strumous diathesis, was attacked with inflammation of the hip-joint three years ago. She was attended by a gentleman in the neighbourhood of Wandsworth, who adopted such means as were most judicious to arrest inflammation; yet it progressed. Subsequently she became an in-patient at a London hospital, where she remained three months. After leaving the hospital, she came under the care of another hospital surgeon.

When I saw her, in March, the right buttock was flattened; the muscles of the limb were wasted; the pelvis was oblique, and so much inclined that, standing upright, the toes of the right foot alone touched the ground, the heel being drawn up. There was no shortening of the limb. The spine was curved considerably towards the left side. The hip-joint was motionless. There was neither pain in the hip nor in the knee. Pain had been excessive, even to prevent sleep; but it had entirely ceased for four months.

Having fixed the pelvis, I attempted to flex the thigh, but found that the adhesions were too firm to yield to any pressure that I could employ, when applied gradually. I therefore endeavoured by a series of jerks to break through the adhesions. They yielded slowly, imparting to the hand a sensation of tearing. Then I flexed and again extended the limb. Having previously formed a gutta-percha splint, I applied it to keep the joint at rest in the same position as before the operation. The limb was then bandaged. No inflammation was excited, and very little pain was felt after the operation. The limb remained at rest, and the ban-

dages were not removed for eight days ; at the expiration of which time passive motion was instituted ; at first, gently and to a slight extent only ; but it was gradually increased until the limb could be perfectly flexed and extended.

Three months after the rupture of the adhesions, there was considerable power of voluntary motion ; the obliquity of the pelvis was in great measure overcome, and the sole of the foot was in contact with the ground. The patient could walk about the house supported by a crutch. Two months later, namely, in August, the limb could be flexed and extended without assistance, though not to the full extent ; the obliquity of the pelvis was entirely overcome, and the curvature of the spine was at this time almost removed ; the sole of the foot was in perfect contact with the ground, and the foot could be well flexed in walking.

In October some weakness of the limb still remained, so that a stick was still used for support ; the buttock, however, was fuller and firmer, and the motions of the thigh were easy and painless, and with very slight effort they could be carried to the full extent of normal motion.

In December she walked well with a stick, and with only a slight degree of apparent weakness.

Partial Ankylosis of the Hip-joint.

CASE 6.—F. C. æt. 25, an officer in the Royal Artillery, suffered when in Ceylon, in 1855, from rheumatism. Several joints were affected, but especially the left hip was inflamed. He suffered during several months, and at length it was discovered that the motion of the hip-joint was lost. I first saw him in January, 1857. I found both lower extremities of the same length ; the head of the femur occupying the cotyloid cavity ; the glutæi muscles of the left side much flattened, and no power of flexion or extension of the limb, nor other motion than a slight, just appreciable, lateral motion of the hip. After examining the limb I had no doubt that the adhesions were fibrous. I therefore recommended that they should be ruptured. He was, however, at that time under orders to proceed with troops to Canton,

and the operation was therefore postponed until his return. He embarked during the following week, and would have sailed on the morrow, when orders were received to detain the vessel for three weeks. He immediately returned to London, and having obtained leave of absence, he determined, with Dr. Wood and myself, that an attempt should be made to regain the motion of the joint.

January 24th.—Chloroform was administered by Dr. Snow, and there were present at the operation Drs. Wood and Partridge and Mr. William Pile.

When the muscles were perfectly relaxed, I fixed the pelvis with one hand, and with the other attempted to flex the thigh, which I succeeded in doing after jerking the limb, without using much force, several times. The adhesions yielded gradually, and without a snap or any distinct sensation of tearing. And as soon as resistance was found to have been overcome, a gutta-percha splint, which had been previously shaped, was applied, and no further motion of the limb was permitted. On recovery from the effects of chloroform, my patient was not easily assured that the adhesions had been ruptured. He felt no pain; but slept well during the night without an opiate. He remained quiet in bed during the four following days; at the end of which time the splint was removed, and gentle movements of flexion and extension were made. These motions did not cause pain, or it was so slight that it ceased as the motion ceased. The splint was reapplied and worn for two more days, when it was left off entirely. During this time he walked about the room, and now motion was imparted to the limb every day; at first with the hand, the ankle being grasped, and afterwards more force was used by means of ropes and pulleys, to remove the muscular tension and retraction. At first a stick was used for support in walking; but this was soon thrown aside, for he walked as firmly as he had ever walked, without a halt in his gait, and with great comfort to himself. It is now six weeks since the operation was done. The motion of the joint is not yet perfect; but it is so considerable that the limb can

be extended as much as the other limb ; it can be abducted to within one inch of the motion of the other limb, and it can be flexed beyond a right angle.

Partial Ankylosis of the Hip-joint.

CASE 7.—H. C—, æt. 21, November, 1856. When nine years old, he was attacked, after exposure to cold, with inflammation of the left hip. Great effusion around the joint, with excessive pain, followed, and lasted many months, when a stiff joint resulted. When I saw him, in November, 1856, the limb was much atrophied ; the glutæi muscles especially were much wasted ; the limb was one inch shorter than the other ; the head of the bone occupied the cotyloid cavity ; there was not appreciable motion at the hip-joint. From the sensation which was communicated to the hand, however, I believed that the adhesions were fibrous, and that they might be ruptured. I therefore advised that chloroform should be administered, and that an attempt should then be made to separate the adhesions.

November 20th.—Chloroform was administered by Dr. Gibb. When the muscles were perfectly relaxed, the pelvis was fixed by Dr. Trouncer, and I attempted to flex the thigh upon the pelvis. With a very slight effort, the adhesions snapped audibly, and the motions of flexion and extension were immediately free. A gutta-percha splint was then applied to keep the joint at rest. Very slight pain succeeded the operation, and in the evening he was entirely free from pain. He slept well during the night. On the third day the splint was removed, and slight motion was given to the limb. This was done without pain. No inflammation followed the operation ; but each day the motion of the joint became more free. After ten days, more forcible extension, by means of ropes and pulleys, was employed to overcome muscular retraction and to gain the free use of the joint. One month after the rupture of the adhesions, the thigh could unassisted be raised beyond a right angle with the pelvis. And in January he walked freely, with a raised sole to his boot, and with the assistance

of a stick. My patient now expresses strongly his sense of the pleasure which he derives from being able to move the limb at the hip-joint and of being able to walk without the necessity of moving the trunk simultaneously with the thigh and without the intervention of the joint, as he was formerly compelled to move.

CASE 8.—S. D—, æt. 8, November, 1856. When three years old, he was jerked up from the ground by his nurse, who held him by the forearm. Inflammation of the elbow followed, and the joint became perfectly stiff and immovable.

The arm was flexed at an obtuse angle, the hand being in a semiprone position; there was no motion at the elbow, nor was there any movement of the radius. The muscles of the limb were shrunk. The boy was strong and healthy, and of a sanguineous temperament. Although there was no motion at the elbow, neither muscular tension, nor the slightest perceptible motion under chloroform, yet it was not difficult to assert that the union was not bony, but that it was of a softer and more yielding character.

When chloroform had been administered, I attempted to flex and extend the arm, and soon gained slight motion, which rapidly increased without any sensation of tearing, but with a gradual loosening of the structures around the joint, until flexion and extension were perfect. I was not able to rotate the radius. A wet bandage was applied, and the arm was encased in an apparatus, which was movable at the elbow with a rack and pinion joint, for flexion and extension; it also had a movement to effect rotation of the radius. The arm was held at the same angle as before the operation.

On the following day, November 23d, the elbow was slightly tender to the touch, but otherwise painless. The boy had suffered an inconsiderable amount of pain after the operation; all pain was removed on the application of cold. He slept well throughout the night without an opiate.

November 24th.—I moved the forearm upon the arm

without exciting pain, and continued these movements on alternate days, for a minute or two each time, until November 29th, when I again placed him under the influence of chloroform. I could now rotate the radius perfectly. The adhesions yielded suddenly and completely, without the application of much force. The limb was again encased as before, and cold was applied to relieve heat and pain. No inflammation occurred, and the elbow was only very slightly tender on pressure. Every other day the motions of flexion and extension and of rotation of the radius were continued, and were gradually increased from slight movements, until the limb could be nearly perfectly extended, and perfectly flexed.

January 19, 1857.—He had some power of voluntary motion, and, without the apparatus, the arm could be flexed and extended to more than half of its normal extent of motion, without force and without pain.

Such, then, is the mode of treatment which I have adopted in these cases. Where the muscles were retracted so as to prevent flexion and extension, their tendons were in the first instance divided, together with such portions of fascia as might interfere with the extending process; and the punctures having healed, the adhesions were ruptured by force, more or less suddenly applied, in the directions of flexion and extension.

The punctures being allowed to heal before extension is made, the subsequent injuries bear the innocent character of subcutaneous wounds. And also, the tendons being divided before extension is made, luxations are avoided. The advantage of manual power is so evident in the treatment of these cases that I conceive instrumental force (such, for instance, as was used by Louvrier) should never be employed. For not only is the operator able to adjust this force to the requirements of the case (and he has sufficient for every form of false ankylosis, and, indeed, to break through bony adhesions), but he may modify it by using gradual pressure, or a series of jerks, or a suddenly imposed force, as may appear most appropriate at the time

of operation. Furthermore, the integuments are much less likely to suffer, and the deeper structures to be bruised than when instrumental force, other than the hand, is employed. And, when contractions are complicated with cicatrices, as frequently happens, undue tension of the skin will require the strictest attention of the operator, that laceration may not occur. Also, it should be borne in mind that the integument is more easily ruptured where inflammation has existed, and where cicatrices have formed, than when it retains its normal extensibility. When, under these circumstances, the tension of the skin is great, it is prudent to diminish the extending force in that direction at least, and even to complete the breaking down of the adhesions on a future occasion, rather than to endanger the success of the operation by the smallest rent in the integuments.

Partial luxation of the tibia frequently exists together with contraction of the limb. The head of the tibia is then held in close and forcible apposition with the condyles of the femur, from which caries may probably result. Extension of the limb, and restoration of the articular surfaces to their relative normal positions, is effected in these cases with the greatest advantage.

According to Langenbeck, necrosis of a portion of an epiphysis should not deter from the employment of forcible rupture of false ankylosis. It need scarcely be said, however, that when disease of the epiphysis is known to exist, more than ordinary care should be taken, lest, in endeavouring to rupture the tough adhesions, the bone should be fractured.

Thus I have endeavoured to show that forcible rupture of partially ankylosed surfaces may be safely and advantageously undertaken. The operation is less hazardous than resection of the articular surfaces, and the results of the operation are infinitely superior to those which are obtained after resection.