William Mitchell Banks Lecture

ON

THE PROBLEM OF THE STIFF JOINT

DELIVERED AT THE LIVERPOOL MEDICAL INSTITUTION

NOVEMBER 19TH, 1931

BY

SIR ROBERT JONES, Bt., K.B.E., C.B., F.R.C.S.

As an old pupil of Sir William Mitchell Banks I have a vivid recollection of his strong and charming personality and of his influence over his colleagues, not only in this city, but throughout the country. He was, without exception, the most interesting and lucid lecturer to whom I have ever listened, and his anatomical demonstrations, enriched by aphorism and an eloquence peculiarly his own, fascinated all who were privileged to attend his classes. His eminence as a surgeon will always be recognized; his contributions to the literature of his art are many and enduring. Medical education was a subject dear to his heart, and we in Liverpool will remember gratefully the important part he played in laying the foundations of our University. Our profession is enriched by the example he set in maintaining its noblest traditions.

In one of the last letters I received from Sir William he deplored the fact that the bone-setters were making inroads on the reputation of our profession, and he asked, "When shall we wake up?" This has influenced me in choosing for the title of my address "The problem of the stiff joint." It is a subject which is of interest to surgeons generally, and has a far-reaching importance to every practitioner of medicine. The field it covers is so extensive that in the brief time at my disposal I can only touch lightly upon points which seem essential and fundamental. The ordinary textbook, if it deals with the question at all, does so in an indefinite way, and invariably leaves us without practical guidance; as a sequel to this we have unqualified practitioners all over the country who render stiff joints mobile with a success sometimes very disconcerting. Later on I shall deal in some detail with so-called "bone-setting" or "manipulative surgery," and formulate rules which may guide us in our endeavour to prevent a joint from becoming stiff, and, if stiffness has occurred, try to indicate whether rest or movement is needed. This will entail a repetition of principles which I have taught for many years, and perhaps I may be excused if my address seems elementary, as my object is to be helpful to all practitioners interested in the problem.

When a joint is stiff it is generally due to the presence of adhesions, which may be found within a joint or around it. Very often they are both extra- and intra-articular. They may be the sole cause of the stiffness, or complicate disease.

WHAT IS AN ADHESION?

An adhesion is a pathological band restricting the normal movement between two adjacent tissues, and it is caused by a serous or haemorrhagic exudate from the blood vessels, either inflammatory or traumatic in origin. At first this exudate is soft and elastic; later, as its structure becomes more definitely fibrous, it loses its elasticity and becomes more dense and less vascular. An adhesion in its latest stage, therefore, is a cicatrix. If an inflamed joint be kept at rest too long after inflammation has abated then the process of healing may lead to the formation of unnecessary bands of fibrous tissue.

To simplify discussion adhesions may be divided into two groups: (a) the extra-articular; (b) the intra-articular.

The extra-articular type may be connected with the capsule, with the ligaments, or with muscular origins and insertions. They may be due to old organized blood clot

and plastic effusion following tears in muscle. They may form between muscles and their sheaths, or be due to the irritation of displaced tendons, or the slipping of muscles or muscular fibres over bony prominences, as so often occurs about the spine. Although stiffness in joints is usually the direct result of adhesions, mobility of a joint may sometimes be interfered with by adaptive shortening of muscles, and other structures due to posture, or strain, or loss of substance. It is met with in myositis ossificans, Volkmann's ischaemic paralysis, and in the form of sclerosing fibrositis, such as we find in Dupuytren's contraction. It is found in an intractable form in many deep scars about joints.

Intra-articular stiffness may be the result of a simple trauma with or without infection. In its simplest form it may consist of an adhesive fixation between adjacent portions of the synovial membrane or capsule. It often follows injuries to the semilunar cartilages, the infra-patellar pad, dislocations, fractures into the joint, or it may result from acute or chronic infection. For purposes of this address I will use the term arthritis as denoting an inflammation involving the cartilage or bone, or both, as distinct from a simple synovitis. It is an artificial distinction, but will simplify the problem with which I deal.

REST OR MOVEMENT

We may lay down as a rule of practice, admitting of few exceptions, that a joint stiffened by simple adhesions, whether intra- or extra-articular, should be moved actively or passively, or even forcibly if necessary. In contradistinction to this, with exceptions which will be stated, a joint stiffened by arthritis should be kept at rest until pain and inflammation have subsided, when movements of a special kind may be allowed. It is essential, therefore, to make a differential diagnosis between the two conditions which will provide a safe and practical guide to treatment.

The rule is a simple one and allows of few exceptions. A joint whose movement is limited in *all* directions is, or has been, subject to arthritis, while a joint which is limited in certain directions *only*, movement being normal in others, is not arthritic. This is more obvious in joints which can be moved in many directions, such as the wrist, hip, shoulder, and spine, than in the knee and elbow, where movement is mainly one of flexion and extension; but, as I will demonstrate, it applies to these also.

This differentiation does not apply to septic infections involving the tissues outside the joint nor to fractures within the joint, nor to joints temporarily stiffened from long fixation.

We can, however, definitely assume that a joint whose movement is not limited in every direction is free from arthritis. Furthermore, if we cannot find any limitation of movement in a joint we may assume it is free from both arthritis and adhesions, but the examination must be very methodical, for adhesions may exist without obvious stiffness, as I will explain when dealing with movements of the knee. In early arthritis rigidity is due to protective muscular action, which disappears under an anaesthetic. Later, this physiological rigidity will become pathological.

I will state a concrete example in order to make my meaning more clear in regard to differential diagnosis, and the spine will afford a good instance. A patient complains of pain in his back and he is asked to flex, extend, rotate, and laterally move his spine throughout its full range. If he can do this freely both arthritis and limiting adhesions can be excluded. If his spine is tender, but he cannot flex it fully or deviate it laterally, yet can, however, hyperextend it normally, we may assume the absence of arthritis. We may affirm, therefore, that a spine with movements limited in all directions is arthritic,

and, further, if one or more of its movements are normal in range we can exclude the presence of arthritis. These facts definitely simplify the solution of our problem as it affects the question of rest or movement.

It will help us still further if we assume that rigidity closely following upon trauma is generally due to adhesions which sometimes form with great rapidity. The stiffness following synovitis, acute or chronic, is due to adhesions formed between different portions of the inflamed synovial membrane. When it accompanies an arthritis it is a slow and continuous process, and is due to bands binding all the tissues entering into the formation of the joint.

Definite localized pain is experienced when adhesions are put on strain, and the tenderness can generally be localized on pressure. It is more diffuse in arthritis. An adhesion is most painful when a joint is moved, and less so when the joint surfaces are pressed together. In arthritis, pain is more pronounced when pressure is brought to bear on the bone surfaces. The temperature of the arthritic joint is usually increased over the whole articulation, while adhesions may produce localized surface temperature, but generally there is none. In arthritis the stiffness is progressive; in adhesions it is stationary or retrogressive. In arthritis, wasting of the limb is in excess of that due to desuetude—a symptom which does not apply to stiffness due to adhesions. It should be unnecessary to suggest that radiography should be used in all cases of disease and injuries of the joints. None of us, no matter how experienced, can afford to neglect the information to be obtained in this way.

In many types of arthritis we hope to obtain a varying amount of movement after the inflammatory symptoms have subsided. In adult tuberculosis a bony ankylosis—although it only happens exceptionally—gives us least anxiety as to the future. This is especially so in weight-bearing joints, such as the ankle, knee, and hip, which are liable to break down on strain, even after many years of apparent recovery. Tuberculosis in the adult presents a serious problem, for, at the end of treatment, which may last many years, with danger of a dissemination of the bacillus, a bony ankylosis rarely occurs; but it is a bony ankylosis we want. For these reasons in the present stage of our knowledge an ankylosing operation on the ankle, knee, or hip is justifiable as soon as an accurate diagnosis has been made. It saves time in an adult patient, lessens danger, and secures a firm joint for all time. This, of course, does not apply to children. Movement is anathema to a tuberculous joint during the progress of disease, and we should make ourselves familiar with its clinical manifestations in its early stages, for here radiography may not be convincing. A skin test, though helpful in a doubtful case, is more reliable when negative than positive, while the bacillus is often difficult to find in fluid aspirated from the joint. In spite of our clinical experience there will remain exceptional cases where a diagnosis must ultimately depend upon histological findings or upon animal inoculation.

PREVENTION OF STIFFNESS

In treating joints we aim at obtaining the best functional results, and we should therefore combat all the elements which make for stiffness, the chief of which is adhesions. It is necessary to rest an arthritic joint until pain and inflammation have disappeared. In certain cases of chronic arthritis it is sometimes possible to prevent the formation of firm adhesions. This should only be attempted when the painful active stage is passed. The patient may be allowed to move his joint within a painless area, or even the surgeon may employ a passive movement once a day and then let the joint rest. It

is only justifiable to proceed with this when neither persistent pain nor reaction occurs. In the non-arthritic joint, movement is needed before the adhesions have formed, or, failing that, before they have become firm. We must bear in mind that the presence of firm adhesions generally denotes some defect in treatment, and may be used against us as a reproach. Manipulative surgery would be but rarely invoked if we all made a practice of strangling an adhesion at its birth.

When we examine an injured joint we must endeavour to make a precise diagnosis and to appreciate its pathology. If ligaments are torn they should be protected from strain until movements can safely be practised. Massage immediately after the injury, before effusion has taken place, checks haemorrhage into the part, stops effusion of lymph, relieves pain, and leaves the tissues ready to commence immediate union. Massage does not include movement. A masseur who will not massage without moving a joint often disturbs tissues which should be left at rest to undergo repairs. If we understand the anatomy and function of an injured ligament certain movements of the joint can be conducted without straining it; the joint should not be dealt with as if an active inflammation existed, for movement carefully supervised expedites the restoration of function. Local effusion of blood should be lessened by pressure, for pain is due to mechanical tension, and tension to serous and haemorrhagic exudate, and this exudate is the basis for the development of adhesions. If the joint is sprained, elastic pressure should be firmly applied in order to prevent or minimize effusion and allow of the repair of the injured structures. In the knee, for instance, if the internal lateral ligament is strained, pressure should be applied by pad and bandage, which prevents effusion about the torn ligament and distension of the joint, which so often accompanies this injury. In this early stage no movement should be allowed which gives rise to pain, and, later, when movement is allowed, care should be taken to prevent strain upon the injured ligament. Neglect of this rule is often the cause of lateral yielding of the joint, for the torn ligament, although united, may lengthen under strain. In the lower extremity active movements should be practised in the first place without the incidence of body weight, and when walking is prescribed body weight should be deflected from the injured ligament. For instance, by raising the heel of the boot on the inner border, the internal lateral ligament of the knee and of the ankle are relieved from strain. The same principles apply to strains of tendons, as exemplified in partial or complete rupture of the tendo Achillis, where we first keep the ankle in plantar flexion until healing takes place, and then add to the height of the heel to avoid strain during walking. These rules will prove a useful guide, and, although obvious and elementary, they seem constantly to be neglected.

STIFFNESS FOLLOWING FRACTURES IN AND ABOUT JOINTS

I have often stated that prolonged rest of a healthy joint within the limits of its normal range of movement will not give rise to more than a temporary stiffness, easily overcome by passive movements in the case of the adolescent and the young adult. In the aged this stiffness is more pronounced. Against this it may be urged that a very intractable stiffness sometimes follows fractures of the femur near the knee when this joint has been kept extended for a considerable time. This is perfectly true, but other factors than rest are involved. In such cases considerable (and, at the time, unrecognized) injury may have occurred to the joint, and be responsible for the development of adhesions. In addition to this, reaction

occurs from the stretching of capsule and ligaments. Both these complications must be avoided without imperilling union of the fractured ends. The problem must be worked out in each individual case. When fracture occurs in middle life and in the aged, where there has probably been damage to the joint structures, the joint should be slightly flexed from time to time, and should never be fixed in the fully extended—which so often becomes the hyperextended—position. A joint *stiffens* much more readily if it is rested in the fully extended, rather than in the slightly flexed, position. This is true of all joints, but more especially of the knee, elbow, and fingers. We found this emphasized during the great war, where fractures of the humerus were treated by extension of the elbow, and injuries of the wrist were fixed in dorsiflexion splints with straight handpiece, which involved full extension of the fingers. Where the handpiece was curved, allowing of slight flexion of the joints, these stiff fingers were rarely encountered. Fractures into the elbow-, knee-, and ankle-joints usually unite sufficiently in three or four weeks to permit of gentle passive movements. The stiff joints following compound fractures of the bones come within a different class, and will be referred to later. To avoid adhesions, therefore, we should allay all inflammatory symptoms; prevent or lessen local effusion by pressure; massage injured structures early; practise movements which place no strain on the injured tissues, and so encourage early active function.

TREATMENT OF STIFFNESS DUE TO ARTHRITIS

Radiology is obviously of paramount importance in helping us to decide whether a joint should be moved or not. It has a definite message in tuberculosis of bone, and in every variety of non-tuberculous disease it will help us. If we find extensive destruction of bone and disappearance of cartilage, as shown by diminution of joint space, manipulation will not be indicated, and in those cases of minor changes we must approach the problem of movement with great caution. Movement has no part in the treatment of arthritis during the painful inflammatory stage. It has but a limited scope where recovery from active disease has occurred. It is not easy to fix the moment when disease is no longer active in an arthritic joint, but the absence of pain and radiological evidence of repair are welcome signs.

We may be sure that a joint has recovered from disease when its range of movement is not diminished by use, or, in the case of ankylosis, when its position does not alter by use. If a joint has a range of movement of 40 degrees, and this range is diminished by 20 or 30 degrees when use has been allowed, we can be sure that disease is still active. Or supposing a joint is fixed at a certain angle by fibrous ankylosis, and, when used, it becomes *fixed* at another angle, we know that recovery has not taken place, and that manipulation would be disastrous. Or, again, if after use it remains at the same angle, we look upon the joint as recovered, with what Thomas termed a fixed, sound ankylosis. Should the patient return with an increasing range of movement we may consider the joint free from active disease. A recognition of these signs of recovery has a close relationship to treatment. When the joint seems to be quiescent, free from pain, with normal temperature, and weight-bearing produces no reaction, while the *x-ray* shows evidence of repair, these tests of recovery should be applied, and, if satisfactory, the question may arise whether surgical assistance is needed to increase the range of movement. If recovery has taken place and the range of movement increases, be it ever so slowly, we should trust to active rather than to passive movements, and these should be practised in the absence of weight-bearing. If the increase in the range of movement ceases and then

remains stationary for a period the question of passive assistance may arise, but forcible manipulation is not to be considered. In the lower extremity, if the range of flexion increases when walking is permitted, while extension becomes more limited, the joint requires further protection. In the case of recovered non-tuberculous arthritis we may decide to try to increase the range of movement. We are helped in our decision by the *x-ray* photograph and by the appearance of the joint. If it has stood the strain of exercise without reaction we may increase the range of movement 10 or 20 degrees, and fix it at the new angle for twenty-four or forty-eight hours to avoid reaction; the joint can then be exercised at first without, and later with, the incidence of body weight. If the increased range is maintained the same procedure is repeated. If, on the contrary, reaction occurs and the range of movement is not maintained, or perhaps lessened, passive movements must not be permitted.

PROLONGED IMMOBILIZATION OF A FRACTURED LIMB

As I have already stated, immobilization in an adolescent or young adult need give no anxiety. After six or eight weeks the knee will recover free movement, even though there has been a sufficient pull upon it to maintain full alignment of the fracture. We have rarely experienced any trouble. After a compound suppurating fracture, where one meets with a mild peri-articular infection, or where the joint has been badly strained or forced into hyperextension, the stiffness may be pronounced and very resistant. These conditions should be dealt with by manipulation in stages, and the joint should be fixed for a few days in each new position. Lest the fracture is not firmly consolidated it must be protected from strain during manipulation by the firm application of splints. In the case of the femur the patient should be placed upon his face with his thigh splinted, and the assistant should put firm pressure over the fracture while the knee is flexed.

We are often confronted with an old mal-union or non-union of the femur and a stiff knee-joint. We should always endeavour to secure movement in the knee before operating upon the bone. If the rigidity is allowed to remain during the months necessary to treat the fracture the stiffness of the joint becomes more and more intractable. Before manipulating the knee we must make sure that the patella is mobile and that the quadriceps is not fixed to the femur, otherwise the quadriceps may be ruptured, the patella broken, or the tubercle of the tibia evulsed. It may be necessary to free these structures by open operation.

ACTIVE AND PASSIVE MOVEMENTS

And now a word about active and passive movements, for by this branch of physiotherapy we prevent the formation of adhesions and cure the less resistant types. When a joint has been sprained, and the preliminary treatment (which I have already described) has ended, the question of movement arises. If adhesions have formed movement is indicated, and active movements are to be preferred to passive ones. Active movements, being voluntary, are sure to be gentle, being limited by pain, while the muscle is truly exercised. Passive movements, unless very skillfully performed, are apt to add to cicatricial tissue and interfere with repair. In young children and highly nervous people it may be necessary to prescribe passive movements, but if you have a choice, trust to the active type. When a joint has recovered from a fracture, or mild arthritis, the masseur should be warned not to employ what I have termed the "pump handle" method when passive movements are prescribed. It consists in

putting the joint through each of its movements several times instead of once. This often produces a reaction which will stiffen, not mobilize, a joint. It most often occurs in the elbow, which becomes stiff and painful, and often alarms the practitioner. We first exclude the presence of myositis ossificans, and then assume that the symptoms are the result of excessive movements. They disappear when the joint is rested for a few days, and then active movements may be allowed. It cannot be repeated too often that if passive movement is adopted it should be confined to one single movement in each direction once a day, and in the interval the arm should be slung at right angles. No adhesions can occur in twenty-four hours which cannot easily be overcome.

MYOSITIS OSSIFICANS TRAUMATICA

For a moment we will deal with a serious complication, known as traumatic myositis ossificans. It may occur after any dislocation or fracture in the neighbourhood of a joint, but is most commonly found in the region of the elbow. It requires very careful handling. Its onset is gradual and usually painless, and when established may result in a locking of the joint. It is due to tearing of the muscular and periosteal tissue from bone, accompanied by haemorrhage. Fragments of periosteum and osteogenic tissue are pulled away, and thus the formation of new bone takes place along the interfibrillary and intermuscular septa. The symptoms are insidious. An elbow which is doing well begins to get stiff in the third or fourth week. The practitioner, omitting to take an *x*-ray photograph, prescribes passive movements—a very dangerous thing to do. The *x*-ray would have shown a cloudiness about the attachment of some muscle—usually the brachialis anticus. In two or three weeks this shadow becomes more dense, and traces of bone structure are present. The elbow in such case should be kept quite still until evidence is obtained that bone deposit has ended. If the elbow has been slung at an acute angle it should be altered and placed in the most useful functional position, lest extra-articular ankylosis occur. When we are sure that no further bone deposit will take place—a fact easily ascertained by successive *x* rays—very gentle movements may be allowed. The deposit may be slowly absorbed or it may remain quiescent. If it causes disability it may be removed, but if it does not materially affect movement it should not be interfered with; during its developmental stage an operation often results in fresh deposit of bone. These deposits may remain for many months, and ultimately be absorbed, or they may develop all round the joint, producing a permanent ankylosis. I emphasize this in order to restrain you from employing either massage or movements in this condition.

ISCHAEMIC PALSY

Another and more alarming complication in fractures about the elbow is known as Volkmann's ischaemic paralysis. It often produces ankylosis of the elbow-joint, with paralysis and rigidity of the fingers. The condition is due to acute venous obstruction. It may be due to pressure from within, such as haemorrhage into the ante-cubital fossa, pressure from displaced fragments, or pressure from without due to tight bandaging.

Symptoms usually begin in the space of a few hours after injury; the hand is painful, the fingers discoloured and numb, and voluntary movements may be lost. Irreparable mischief may take place in forty-eight hours. Treatment should be immediate; every minute is important. The arm should be released from all restraint likely to produce obstruction. If this is not effective valuable time must not be wasted, and the blood clot should be evacuated by an incision into the ante-cubital space. This prompt action, based as it is on a sound pathological

basis, may save a calamity. I have no time to discuss the mechanical treatment of the stiff fingers, but I must warn you when dealing with fractures and dislocations about the elbow, never to flex the elbow-joint fully without first completely reducing the displaced bones. It is a highly dangerous proceeding.

FORCIBLE MANIPULATIONS

I shall now deal in some detail with the subject of forcible manipulation, which is a branch of surgery that from time immemorial has been neglected by our profession, and as a direct consequence much of it has fallen into the hands of the unqualified practitioner. Let there be no mistake; this has seriously undermined the public confidence, which has on occasions amounted to open hostility. If we honestly face the facts this attitude should cause us no surprise. No excuse will avail us when a stiff joint, which has been treated for many months by various surgeons and practitioners without effect, rapidly regains its mobility and function at the hands of an irregular practitioner. We should be self-critical, and ask why we missed such an opportunity ourselves. The problem is not solved by pointing out mistakes made by the unqualified—the question at issue is their success. Reputations are not made in any walk of life simply by failures. Failures are common to us all, and it is a far wiser and more dignified attitude on our part to improve our armamentarium than dwell upon the mistakes made by others. With few exceptions a stiff joint is based on a clearly defined pathological basis, and a large proportion of cases cured by the manipulator represent a failure on the part of our profession. It is not a pleasant thought, but it is true. We are apt to shrug our shoulders and show contempt when a patient is told that "a vertebra is out; I will replace it." Such a dramatic statement may have a psychological effect, and be an excellent preparation for treatment, because it inspires hope and compels confidence. Every practitioner knows the value of such a stimulus if he is to control the nervous element so often associated with an organic lesion. In the neuro-mimetic and the neuro-organic it is an essential part of treatment. The success of the manipulator has given rise to a widespread belief that he has been born with a "gift" or "intuition." Of this we have no evidence. It is obvious there is nothing which he does that should not be undertaken more safely by any surgeon or practitioner who possesses a knowledge of the anatomy and pathology of the joints, but—and this is fundamental—he must become familiar with methods of manipulation which are safe and thorough; he must learn the art, and he must know the right joint to tackle—a mistake on his part is far less excusable than when made by the unqualified. It is often stated of H. O. Thomas that he had an unreasonable objection to moving joints, and that the breaking down of adhesions was anathema to him. His experience of bone-setters was based on their procedure over forty years ago, when not a week passed but he came in contact with tuberculous joints which had been forcibly moved, sometimes with tragic consequence. Radiography was unknown then, and joints were broken down indiscriminately; in these days an *x*-ray photograph is in the hands of everybody, and such calamities are proportionately few.

I have endeavoured to indicate the type of joint which should be moved, and the stage at which this should be done, drawing attention to certain doubtful conditions which should be approached tentatively and even experimentally, and I have laid down rules which should guide us in deciding whether a joint has recovered from an arthritis or not. In rupturing non-arthritic adhesions there are certain points I wish to emphasize. Recent adhesions may be broken down under gas and oxygen.

When they are of firm character full anaesthesia is essential, for complete muscular relaxation must be secured before manipulation can be thoroughly performed; they cannot be dealt with satisfactorily if there is the least muscular resistance. An advantage of the lighter anaesthesia is that the patient can be made to move his joint immediately consciousness returns, and this has an excellent moral effect. We should be familiar with the range of movements in the various joints if we are to avoid strain. The range may differ in individuals, and the sound practice is to take the healthy joint as a guide, comparing its movements during the operation with those on the affected side. After the joint has been conducted through its complete range of movement we should be satisfied; it is unnecessary to repeat it.

When adhesions are broken down the manipulation should be completed on one occasion, unless they are exceedingly firm, and the limb should be placed in the position of full correction while the patient is unconscious. If, for instance, the shoulder has been fixed in adduction he should be allowed to awake with the arm in full abduction. If, on the other hand, the manipulation has been very severe, and reaction is feared, the joint should be rested for a day or two, massage being employed instead of movements.

I have emphasized the necessity of putting the joint through its complete range of movements, and to make this clear I will briefly describe the technique which I follow on the three joints most generally associated with adhesions—the knee, shoulder, and elbow.

TECHNIQUE IN MANIPULATING THE KNEE

In breaking down adhesions the joint should be fully flexed, and in that position the leg is rotated out and in. This rotation should be continued while the knee is being fully extended, care being taken that the extension is complete. The knee is again flexed over the surgeon's forearm, which is placed across the popliteal space—in this way the tibia is levered slightly forward. If the adhesions are in front of the joint the knee should be flexed while the hip-joint is hyperextended, in order that extra tension may be put upon the structures in front of the joint. This is a most important movement, and is often neglected.

If, after injury, a patient is unable to extend his knee fully, we may suspect an unreduced semilunar cartilage, sometimes, but far more rarely, a fracture or evulsion of the tibial spine, clearly seen on an x-ray film. A displaced semilunar cartilage may be reduced by manipulation even after several months. The knee should be flexed and rotated inwards, then abducted during extension in the case of the *internal* cartilage; in dealing with the *external* cartilage the tibia should be rotated outwards and adducted. In addition, the manipulation which I have described for breaking down adhesions should be practised, for adhesions are often found in connexion with a displaced cartilage. Unless the knee extends fully and easily we may be sure the meniscus is not reduced.

THE SHOULDER

The shoulder-joint is very commonly bound down by adhesions even after very slight injury. It is apt to occur in the aged, more especially following fractures and dislocations. All fractures about the shoulder where adhesions may be expected should be treated in the abducted position. In the fragile and aged this position may not be tolerated, and the arm will then have to be kept against the side, and gentle passive movements started in the third week.

In breaking down shoulder adhesions, especially in the aged, great care is needed, for it is not difficult to produce a fracture or dislocation. This unpleasant occurrence is apt to be associated with rotation outwards or abduction, and the padded fist should be pushed into the axilla in support of the head and neck when manipulation is practised. In this joint it is especially necessary to check manipulation by comparing the range of movements with those of the sound side. The patient should lie on his back, with the injured shoulder protruding over the edge of the table. The arm should then

be rotated inwards and outwards, and while the scapula is fixed the arm should be completely adducted and abducted. In this position it should again be rotated inwards and outwards. The scapula should next be released and allowed to move with the arm, while it is fully elevated. In this position it should again be rotated inwards so that the forearm can easily be placed behind the back, and outwards so that the arm can be placed behind the neck. The arm should then be circumducted while being brought down to the side. Finally—and this is an important and often neglected movement—the arms are elevated and the hands placed behind the head, and from this position the arm is pushed backwards, the head of the humerus stretching the front part of the capsule. If adhesions are very firm these movements may have to be done in stages, but where possible it is best that they should be completed on one occasion.

THE ELBOW-JOINT

In breaking down adhesions about the elbow-joint especial care is needed. If they are recent and not accompanied by fracture, the joint should be put through its complete range of movement. If the adhesions are very firm and are associated with a fracture, or follow a dislocation, mobility should be brought about in stages. My practice is first to extend the arm to the point of safety, which I estimate by the degree of resistance it offers, and then I flex it, using only very slight force. The arm is then slung in flexion and kept there for two or three days, when it is extended, and kept in extension for a couple of days. If no reaction has taken place the sling should be removed and active movements allowed. It may be necessary to repeat this routine in a few days. If the range of movement increases with use, no matter how slowly, neither passive nor forced movements should be allowed. We should remember that in children a stiff elbow often becomes mobile with active use when it resents passive movement, and it frequently happens that when massage and passive movements have failed to make any impression, and have been discontinued, the child appears a few months later with a freely movable joint. It is not uncommon to meet with a stiff joint in an adolescent following a fracture through the condyle which has not been accurately reduced. The elbow usually assumes an angle of about 40 degrees from full extension. This ankylosis, if roughly handled, may react and the joint become inflamed; so to avoid that, we flex the elbow without using much force, until strong obstruction is met with, and then we keep it slung in its new position for a few days, after which we find it easy to obtain a further flexion of 10 or 20 degrees. This routine is repeated two or three times, and the result is often most encouraging, for we may secure a considerable range of movement at a more useful angle in a joint that otherwise would remain very stiff.

These manipulations are applied to firm peri-articular or intra-articular adhesions, not those accompanied by destruction of joint surfaces.

AFTER-TREATMENT

The after-treatment of joints following forcible manipulation is important. Active movements should be started as soon as consciousness is restored. It may be necessary to assist these movements passively once a day; active movements should be repeated frequently. If effusion takes place in a joint it is strongly suggestive of the rupture of intra-articular adhesions, but such effusion does not necessarily imply that the manipulation should not have been employed unless it is followed by a progressive diminution of the range of movement. If this occurs rest is called for, the limb being fixed in a position opposed to the contraction. Recovery will be expedited by dealing with the joint persuasively rather than forcibly, but if, even in the presence of considerable pain, the range of movement is increased by exercise, rest is contraindicated. Pain which is sharp and of short duration is negligible, but if pain persists when the joint is at rest it means that a reaction, likely to be followed by stiffness, has set in, and is a danger signal calling for pause. If a patient is able to move his joint freely after manipulation he is encouraged to use it freely. Exercise is better for him than any form of physiotherapy.

The stiffness following chronic arthritis, or firm peri-articular adhesions following sepsis, must be approached with considerable caution. It should be a carefully conducted experiment, for we cannot always predict whether or not a reaction will occur.

I will illustrate this by again taking the knee-joint as an example, assuming that there have been no destructive changes in the bone. If it is fixed in extension it should be moved a few degrees in flexion—the range depending on the resistance. The limb is then placed in a splint in order to retain the knee in its new position. It is rested there for a few days. The bandage is then removed, and the surgeon assists the patient to extend his knee. If this is successful the splint and the knee are still further flexed, and the joint is rested in its new position. If the range of movement is maintained we know we can continue on these lines and bring about a more complete mobilization. If it becomes fixed in its fresh position, and in spite of all coaxing remains fixed, we must face failure, and we must let the joint ankylose in the best functional position. It is well to remember that often when no amount of forcible manipulation will move the knee it may gradually yield under continuous pressure by bandage over splint.

ACUTE SUPPURATIVE SYNOVITIS

A very anxious problem is that of the acute suppurative synovitis, which, without treatment, ends in firm fibrous, or more often bony, ankylosis. Can anything be done to modify or prevent this ankylosis? If it occurs, say, in the knee, immediate evacuation of fluid content is indicated. If this is done while the content is serous or mildly seropurulent, destruction of the joint may be obviated; it should be well washed out with saline, alcohol, or ether. This can conveniently be done by introducing two aspirating needles, one being used as an exit while lotion is driven through the other. This is repeated, if necessary, on several occasions until the discharge is serous; when this has occurred the joint should be fixed for twenty-four hours in extension, and then for the same time in about 50 degrees of flexion to prevent the formation of fixed adhesions, which, in this acute condition, form very rapidly. When the acute symptoms are over, assisted active movements without body weight should be prescribed. If, however, destructive suppuration sets in, the joint should be opened, and movements as initiated by Willems, and developed by Everidge, during the great war, are called for.

Everidge devised a very ingenious apparatus to aid the patient's will power in moving the joint. Two transverse incisions are made into the joint from the inner and outer borders of the patella along the lines of cleavage, each about one inch in length, without involving the lateral ligaments. The cut synovial membrane is stitched to the skin. I had opportunities of examining Everidge's cases during the war, and was very much impressed by what I saw. The joint was treated as if it were an empyema, and 50 per cent. of the cases ended with useful movement. The patients became interested in carrying out the exercises, and several told me that when the joint became painful they evacuated the pus by flexing and extending the joint, and thus obtained relief. By these movements, practised every two hours night and day, the retention of pus was avoided. This treatment is not so successful in suppurative arthritis involving all the elements of the joint, and of no use when osteomyelitis invades the joint from the bones without. Such cases invariably end in ankylosis.

THE RHEUMATOID GROUP OF CASES

The rheumatoid group of cases form a large proportion of the diseases we meet with in joints, and their discussion can be approached from many angles. I will confine myself, and that very briefly, to a few surgical points on their management without reference to the etiological problem they present. For this purpose the groups may be classified as "proliferative" and "degenerative."

The proliferative type, most commonly found in the young, is characteristically polyarticular, the swelling of the joints being firm, dense, and rarely fluctuant. The clinical picture is that of a resistant, long-continued, acute or subacute joint affection, very sensitive and painful, and prone to early malposition and to early ankylosis. The x-ray film shows a bone with a diminished line shadow, somewhat mottled and stippled. The joint space is narrowed, and lipping is not present to any extent. Bony ankylosis is frequent and the prognosis is grave.

The degenerative type is characterized by early lipping and late hyperostosis, and the prognosis is much more favourable, for the destruction of the joint is less rapid, the lesion being first confined to the synovial membrane and to the edges of the joint.

The surgical indication in either condition is preventive. We should visualize the deformities found in the neglected case, and prevent them from occurring, so that if ankylosis takes place the functional disability will be at its minimum. This is usually within the power of the surgeon, and treatment should not be delayed while etiological investigations are being made. A visit to any spa will reveal cases in every condition of life with appalling deformities which should never have happened had there been a working association between a physician and a surgeon. In either type the hips and knees should not be allowed to contract, nor the wrists to palmar-flex. With the disappearance of acute symptoms in the proliferative variety very gentle movements should be encouraged under close observation, for considerable judgement is required to estimate the proportion between rest and movement. The exercises should in the main be active rather than passive, and if persistent pain follows without increase of mobility harm is being done. Where many joints are affected it is wise to apply the test to one, and if no reaction follows, the others can be approached. By choosing the right moment and observing the behaviour of the joint we may be enabled to retain some movement, even in the proliferative type.

In the degenerative group systematic movement without an anaesthetic is called for, but we must sail cautiously between Scylla and Charybdis. Persistent pain and swelling without a gain in movement should warn us of excessive exercise. When many joints are affected and ankylosis seems inevitable we should decide in what positions the limbs should be placed to attain the most useful function. For instance, if we have two ankylosed hips and two ankylosed knees they are more useful slightly flexed at angles which will enable the patient to sit. If these joints are ankylosed in the extended position the plight of the patient is hopeless. This is especially important in elderly people, who are unfitted to bear the strain of later operative correction.

Traumatic osteo-arthritis in which there is no evidence of infection may be caused by the faulty incidence of body weight upon a joint, as so often occurs in mal-united fractures, or from the irritation of an old fracture within the joint. It is often found in haemophilia from the continued presence of haemorrhage, or from trauma due to recurring displacements of the semilunar cartilage, or it may follow occupational strain. The treatment should be modified to suit each individual case.

We very commonly meet with a hypertrophic osteo-arthritis, generally monarticular, which affects elderly people. It frequently follows injury, and most frequently involves the hip-joint. Limitations in movement occur early, and disability, slight at first, slowly increases. In the later stages an x-ray photograph shows a diminution of joint space and progressive lipping. This condition should not be treated in its early stages by fixation of the joint, but movement should be strictly regulated. Exercises should be practised without weight-bearing,

and should be governed by the character and duration of the pain. A pain which rapidly disappears when the joint is rested may be ignored; if, however, it persists for a considerable time we may be certain that the movements of the joint have been excessive and should be modified. In the later stages, if the disease advances, the leg appears shortened, because of adduction and elevation of the pelvis. Pain may be very severe and surgical intervention is called for. We find that adhesions are commonly associated with the bony changes, and often a careful manipulation under anaesthesia gives great relief and increases the range of movement. If the joint moves easily under manipulation no fixation beyond a flannel spica is needed, but if there be excessive osteophytic outgrowths, and the joint feels resistant to manipulation, adduction should be corrected and the joint should be fixed in plaster in the corrected position; subsequently a leather fixation corset should be worn. Operative measures are needed in the more advanced cases, which cannot otherwise be relieved, and where the physical conditions are favourable.

TREATMENT OF FIXED ANKYLOSIS

Before concluding my address I will state very briefly the principles which should guide us in the management of fixed or permanent ankylosis. We know the malpositions where joints become ankylosed if left to the unaided efforts of nature, and I will now indicate the positions which should be aimed at to secure the most useful function.

In the *shoulder* the arm should be abducted to 50 degrees, the elbow resting in front of the coronal plane so that, when it is at right angles and the forearm supinated, the palm of the hand is towards the face. The angle at which an *elbow* is placed will depend upon the patient and his occupation. Most people find it more useful when placed a few degrees below a right angle. If pronation and supination are lost the radius should be held midway between pronation and supination. The *wrist* should be dorsiflexed at an angle of about 25 degrees. The *hip* should be ankylosed with very slight abduction, very slight flexion—20 to 25 degrees—and very slight external rotation. The *knee* should be placed short of complete extension, and the *foot* at right angles to the leg.

OSTEOTOMY

Osteotomy has an important place in the correction of deformity and the restoration of correct alignment. It should not be performed in the presence of active disease. Its uses are mainly in connexion with deformities at the hip or knee, and it is most effective where the ankylosis is bony.

In the hip it is employed to correct rotation, flexion, abduction, and adduction. The position of election is low transtrochanteric or intertrochanteric, although it is sometimes advisable to make the section just below the lesser trochanter. If there is much flexion deformity the higher section should be made, otherwise when the limb is extended the upper end will protrude anteriorly and jeopardize the vessels, or result in a non-union. If the section is intertrochanteric, or through the lower part of the great trochanter, the removal of a wedge of bone may be necessary, especially if the neck is shortened or the head displaced upwards. In all osteotomies of the upper femur the adductors should be divided.

Osteotomy is frequently performed to correct adduction in a tuberculous hip. Adduction is accompanied by elevation of the pelvis on the diseased side, and this results in a practical shortening of the leg. It is due to cicatricial contraction of an unsound ankylosis at the joint; to contraction and shortening of the adductor

muscles; to elevation of the trochanter following absorption or displacement of the head and neck; and is increased when walking, because of faulty deflexion of body weight. Adduction is not primarily the result of walking, for it may occur while the patient is lying if the joint is not efficiently controlled. The main cause is an unsound ankylosis with absorption of bone and the formation of strong cicatricial tissue. If the joint is not controlled the cicatricial contraction proceeds until adduction is complete, and it is at this stage only that an osteotomy can be performed without danger of recurrence. During and after adolescence an extra-articular bony fixation may be employed, either with or without an osteotomy. If the hip has been kept in good position an extra-articular fixation is all that need be done. In children, where adduction is often accompanied by movement, and time is not so important a factor, an extra-articular bony fixation is not indicated. When a bony ankylosis of the knee is accompanied by a lateral deviation, or a genu recurvatum, osteotomy is needed to correct the deformity. This can be performed through the femur or the tibia. If the recurvatum is accompanied by a backward displacement the osteotomy should take place through the knee in order to bring the tibia forward.

ARTHRODESIS, PSEUDARTHROSIS, AND ARTHROPLASTY

We frequently meet with a short fibrous ankylosis which is painful when subjected to strain. In such a case it may be necessary to substitute a bony ankylosis for a fibrous one. This is done by arthrodesis, which is a modified excision, and is most effective in the knee and ankle. The procedure is called for most frequently in adult tubercle, a condition not suitable for a mobilizing operation such as arthroplasty or pseudarthrosis.

For painful monarticular osteo-arthritis of the hip, already referred to, which cannot be dealt with conservatively, an operative attack may be needed. An arthrodesis will transform a weak painful joint which cannot bear weight to a strong and painless limb. This operation, if effectively performed, is a serious one, as it involves a complete disarticulation and a careful apposition of the denuded bones. It should be reserved, therefore, for the comparatively young and healthy, and should not be performed on the weak or aged. An operation which is very effective in these cases, and only takes a few minutes to perform, is the oblique osteotomy introduced by Lorenz for irreducible congenital hips, and known as the "bifurcation operation." It is as successful in monarticular osteo-arthritis as it is in ununited fracture of the femur.

Many operations have been devised by which painless motion may be retained.

INDICATIONS FOR MOBILIZING ANKYLOSED JOINTS

I shall not enter into any details of the various operations which have been employed in order to render ankylosed joints mobile. Some consist in a reconstruction of the joint, others consist of very free removal of bone about the joint, with or without fascial interposition. In other cases excision is performed, while in certain hips where not only has the joint been destroyed, but massive thickening of the peri-articular structures is present, it may be advisable to remove an inch of the femur in its upper third, fat or muscle being placed between the ends, and so a very useful pseudarthrosis is secured. Details of these various operations may be found in modern orthopaedic textbooks. As technique improves the operative field increases, but even now we can offer suggestions which will help us to decide whether we should try to make an ankylosed joint mobile.

All who have had experience of arthroplasty are agreed that the most successful cases are those in which the ankylosis is bony, with comparatively normal-shaped bones. This will include traumatic joints, and those the result of pyaemia. We may exclude tuberculous joints, which so often and for years contain foci of infection.

The operation is contraindicated in the presence of active disease, and should be delayed until at least two years after its complete cessation. It should never be performed in the presence of sinuses, nor where the soft tissues are infiltrated and tense, nor where muscles are atrophied and adherent; nor should it be performed until growth is ended. The joint which responds most favourably to an arthroplasty is the elbow; the knee, although technique has improved, mainly by the excellent work of Putti, is still in the experimental stage. It is an operation which requires the highest judgement and skill on the part of the surgeon, and fortitude on the part of the patient, for the after-treatment is very painful. The elbow is a joint where we can almost promise a satisfactory result—good movement and fair stability; but the ankle-joint, if stiff and painless, should not be mobilized; if painful it should be arthrodesed.

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AVERTIN IN GYNAECOLOGY

A RECORD OF 1,000 CASES

BY

JAMES YOUNG, D.S.O., M.D., F.R.C.S.ED., F.C.O.G.,
GYNAECOLOGIST, ROYAL INFIRMARY, EDINBURGH

In a previous paper I¹ have put on record the impressions gained after the employment of avertin in 345 unselected gynaecological operations. Our experience has now extended to over 1,000 cases, and increasing use has gone to confirm the view expressed in 1929 by Blomfield and Shipway² in their paper introducing avertin to British surgery that it is "a valuable addition to the drugs at the disposal of the anaesthetist."

The method of administration adopted is similar to that described in the previous communication and to that employed by other surgeons, and it is unnecessary here to enter into a detailed description. The procedure is very easily learned. The evening before the operation the bowel is washed out with an enema. One hour before, one-eighth of a grain of morphine is given hypodermically. Before removal from bed, the patient turns on the side and the drug in solution is slowly instilled into the rectum, the administration taking about fifteen minutes. Before the lapse of this period the patient is usually unconscious, the induction of the anaesthesia being smooth and pleasant. Throughout the induction and the period of unconsciousness the anaesthesia is strongly reminiscent of a deep natural sleep. On two or three occasions only have we found some mental excitement during the induction, while on three occasions the patients failed to pass over into complete unconsciousness. In all cases there is complete amnesia. The maximum anaesthesia is reached about thirty minutes after the commencement of the induction, and we plan that this interval will elapse before the operation is begun, although on many occasions, owing to the exigencies of the operating theatre, we have without disadvantage allowed over an hour to pass.

The drug is quickly absorbed from the rectum, but the dissolving fluid remains in the bowel for a longer

time, and in the case of operations carried out in the lithotomy position it is apt to be squeezed out during the examination or the introduction of the speculum, with a consequent soiling of the parts. To prevent this, it is our practice in such cases to withdraw the remaining fluid by means of a rubber catheter immediately before the commencement of the operation.

We employ, as a routine, a dosage of 0.1 gram per kilo of body weight. In very obese patients instead of giving the full ratio we employ a diminished dosage of 0.08 or 0.06 gram per kilo. We use the liquid preparation which contains 1 gram of avertin in each cubic centimetre, and by means of the chart supplied by the makers the respective quantities can be determined easily and rapidly. With this dosage the anaesthesia obtained is not profound, and, although sufficient often to allow of a minor procedure, such as curettage and, occasionally, of a plastic operation for vaginal prolapse, we find it an advantage as a routine to amplify it by means of ether given by the open method. The quantity of ether required is usually much less than that necessary for an unaided inhalation anaesthesia. It may now be claimed that the experience of many clinics engaged in all classes of surgical work has established that, when employed as a "basal anaesthetic" in such dosage as I have mentioned, avertin is a safe drug. During the early days fatalities were recorded, but there can be no doubt that these arose almost invariably from pushing the dosage to the stage of inducing a complete and self-sufficient anaesthesia.

ANALYSIS OF CASES

The drug has been used as the routine anaesthetic in my department during the period under review, and, except where on a few occasions a pelvic swelling—for example, fibroid tumour, pelvic abscess—has so encroached upon the rectum as to impose a mechanical obstacle to the instillation of the fluid, there has been no selection of cases. For this reason the experience can be accepted as representing that of an average gynaecological hospital practice in which, although much of the operating is of a minor nature, there is naturally at the same time a large admixture of grave and emergency material. Thus there were over 200 cases necessitating opening of the abdomen for the carrying out of hysterectomy (71), salpingo-oophorectomy (24), ovariectomy (34) and removal of cysts with twisted pedicles (6), removal of the tube in ruptured tubal pregnancy (16), myomectomy for fibromyoma (10), appendicectomy (25), etc. There were 130 cases of plastic repair for vaginal prolapse. The age of the patients has varied from 5 to 76.

In the series there were five deaths, and in no instance could the fatal issue be attributed either directly or indirectly to the avertin.

The clinical data are briefly as follows:

1. K.117, 8-para, aged 58, was admitted in a collapsed state with complete acute inversion of uterus and vaginal prolapse associated with uterine fibroid. Death occurred twelve hours after hysterectomy.
2. R.156, 4-para, aged 40, with an abdominal swelling of a year's duration, was admitted with a history of vomiting, acute abdominal pain, and fever. Death occurred twenty-eight hours after operation, involving removal of an infected and adherent ovarian tumour.
3. D.762, 1-para, aged 40, was admitted for a marked degree of vaginal prolapse. There was a history of toxic goitre for fourteen years. She developed broncho-pneumonia four days after a modified plastic repair operation, and died ten days later.
4. I.366, 9-para, aged 40, was admitted with a history of breathlessness, menorrhagia, and, recently, of retention of urine. She collapsed four hours after removal of cervical fibroid by total hysterectomy, and died three hours later. The post-mortem revealed chronic toxic changes in spleen, liver, and kidneys.