BRITISH MEDICAL JOURNAL

LONDON SATURDAY FEBRUARY 4 1939

FRACTURES OF THE NECK OF THE FEMUR

A REVIEW OF 33 CONSECUTIVE CASES*

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Some may think that already this subject has claimed an undue share of attention within the last few years. My excuse for bringing it up again is that the profession, including the surgeon, is still in some doubt as to the results which may reasonably be expected to follow the adoption of any one of the various forms of treatment. Put in another way, it may be stated that the Smith-Petersen nail is on its trial. It is therefore desirable that individual experience of this particular method should be published with details.

In reviewing these cases it must be remembered that the mortality rate in the years following the original accident must necessarily be high owing to the high average age of the patients. Ten years ago Calvert investigated this aspect of the problem in the records of the Royal Victoria Hospital and found a mortality of 20 per cent. in a consecutive series of fifty patients, the most recent of whom had sustained the fracture five years before.

The Hey Groves Method of Inserting the Smith-Petersen Nail

For the last three years I have been using the Smith-Petersen three-flanged nail, introduced in most cases according to the method of Hey Groves and employing the apparatus described by him. My experience of those cases has convinced me that both the nail and this particular method of its introduction have justified the claims set forth by their designers. In my opinion they afford a reliable method of obtaining good functional results in a relatively short space of time and with the minimal amount of discomfort and danger to the patient; moreover, the method is applicable to cases of every age, provided only that they are not already moribund and, in general, that they are seen within a few weeks of the injury.

The method conforms to the two great elementary principles in the treatment of all fractures: (1) the fragments are placed in correct apposition; (2) they are held in this position for a sufficient length of time for bony union to take place. It has, however, the theoretically grave disadvantage that it entails the introduction of a non-absorbable material, which must have some deleterious influence on the growth of new bone.

At present the records of instrument makers show from their enormous sales that the use of the nail is immensely popular. We cannot fail to be reminded of the fact that

at one time a similar vogue surrounded Lane's method of treating fractures of long bones by the application of steel plates. And yet this method is now hardly used at all. It may, of course, be that the Smith-Petersen nail is stainless and that therefore it does not to the same extent cause atrophy of the adjacent bone, or that alternative methods of treating fractures of the femoral neck have so many inherent drawbacks. However the problem may be looked at, it is of prime importance to know what results have followed the use of the nail in a series of consecutive cases treated by a single method rather than what may have happened in isolated patients, leaving time to decide the ultimate fate of the method.

Other Methods of Treatment

The alternative methods in use at present are:

1. *The Method of Royal Whitman.*—This must be regarded as the classical method, for it was the first, and for many years the only, really effective attempt to apply these two principles to fracture of the femoral neck. The principle of reduction was met by Whitman by wide abduction and internal rotation. For the satisfaction of the second principle he depended upon fixation in a plaster-of-Paris case extending from the chest to the toes—a matter of some difficulty to most surgeons and beyond the capacity of many patients to bear for the required length of time, having regard to the aged and infirm persons in whom many of these fractures occur, not to mention the fact that it is often followed by a permanently stiff knee-joint. Even in expert hands the Whitman method of treatment fails to secure bony union in many cases—a fact almost universally admitted—whilst in the hands of the average surgeon bony union does not ensue in more than 50 per cent. It is surely a significant fact that in a recent communication the use of the nail has received the benediction of Whitman himself.

2. In theory the soundest method of treating any fracture which tends to remain ununited is by the use of an autogenous bone graft. In Holland the fracture under discussion is a very common accident at all ages owing to the universal use of the bicycle as the national mode of progression. The use of a fibular bone graft has been popularized by Noordenbos, and the results obtained by him and by his followers seem excellent from the functional point of view. The method, however, has the same disadvantage as that of Whitman in requiring fixation in plaster-of-Paris for a considerable length of time.

3. A third method, both novel and ingenious, is that recently suggested by McMurray. The ordinary principles of reduction and its maintenance are despaired of and bony union aimed at in an abnormal position. This is attained by an intertrochanteric osteotomy, the object of which is to transfer

* Presidential Address to the Northern Ireland Branch of the British Medical Association.

the axis of the femoral shaft from its normal alignment to a line passing through the hip-joint. The arguments in its favour are that bony union and painless weight-bearing can be guaranteed and that the operation is a relatively easy one. It possesses, however, the same serious objection as Whitman's method in requiring confinement to bed in plaster-of-Paris for a period of three and a half to four months. I cannot from personal experience criticize this method in the treatment of recent fractures. It comes with the strong backing of the Liverpool School of Orthopaedics, but I doubt if the perfection of function so often attainable by the Smith-Petersen nail can ever be attained by McMurray's operation; and even its author does not suggest that it is ever applicable to patients in the seventh and eighth decades, who in my series constituted one-third of the cases.

General Suitability of the Hey Groves Method

TYPE OF FRACTURE

The three-flanged nail was designed by Smith-Petersen for fracture of the anatomical neck of the femur, hitherto known as the "intracapsular fracture." It finds its chief use in those fractures which are situated in the middle region of the neck—the "mid-collum" fracture of Johansson. It is less suitable for subcapital fractures, and for fractures at the base of the neck it is usually unnecessary. It may be a significant factor that the invention of the nail was synchronous with the introduction and general use of stainless steel for surgical instruments, including plates, nails, screws, etc.

THE ELDERLY

The most severe test of the applicability of any method of treating fractures of the femoral neck is its use in the aged patient. Since the end of 1935 no patient has been refused by me on the score of age alone. One female, aged 82, seen two days after the fracture, was moribund, and died untreated within forty-eight hours. Several patients, in addition to being elderly, had already had the fracture for months, while one who was refused had had it for a year. In all these considerable absorption of the neck had taken place so as to merit the title "pseudarthrosis." Of the thirty-three patients operated on the oldest was 83 and the youngest 43; the average age was $64\frac{1}{2}$; one patient was between 40 and 50; nine between 50 and 60; thirteen between 60 and 70; six between 70 and 80; four over 80.

FRACTURES NOT RECENT

It has been hard to decide when treatment had already been too long delayed for union to occur even after successful insertion of the nail. The features which make healing unlikely, or even impossible, are:

1. *Absorption of the Neck.*—This arises from movement of the limb with the fracture ununited, and in its extreme form a pseudarthrosis already exists. In such cases there are at least three pathological changes present: (a) the muscles and ligaments around the joint are shortened so that reduction may not be possible; (b) even when reduction can be effected the fragments do not "fit" together owing to disappearance of part of the bony tissue of the neck; (c) the fractured surfaces are sclerotic and burnished so that growth of new bone across the gap is prevented.

2. *Sclerosis of the Whole Head.*—This has been described, but has not been met with in this series. A partial and patchy sclerosis, most marked beneath the articular cartilage, has been the apparent cause of a degenerative arthritis in two cases with sound bony union after nailing.

One case, already broken for fourteen months—in which the patient had spent the whole intervening period in bed—has given bony union with, however, only

moderate function. In this case both the head and the upper part of the neck and great trochanter were greatly decalcified. This was looked upon as a hopeful sign from the point of view of union, indicative as it was of good blood supply in both fragments. In long-standing cases of six weeks or more there is a tendency, even when union occurs, for failure of the nail to hold the fragments in the optimum position. Such cases may show gradual displacement of the great trochanter upwards for a quarter to half an inch above the corresponding part of the head. Later on this interferes with abduction, and, though good support and freedom from pain may be obtained, there will be some limitation in normal movements. Or the displacement of the distal fragment may be inwards, accompanied by shortening of the neck and the presence of some degree of coxa vara. In such cases the head of the nail creeps outwards and may ultimately lie as much as half an inch outside the contour of the shaft. This has been found in late x-ray films of patients showing strong bony union and excellent functional results. Under the heading of suitability a note of warning should be sounded. The only death in the series directly attributable to the operation was due to coronary embolism. This patient fell as the result of an anginal attack, sustained a fracture of her hip, and four days after operation a coronary embolus caused her death. This sequence of events was confirmed at the post-mortem examination, and might possibly have been prevented by a period of complete rest in bed before operation.

INSERTION OF THE NAIL

Since the publication of the method of Hey Groves with his apparatus I have been using his original design, and have come to the conclusion that the operative failures have not been due to the method but to some mistake in technique, to allowing the patient to use the limb too freely before bony union had become sufficiently established, or to operating on patients in whom the femoral neck had already been absorbed. Recently Hey Groves has suggested that the operation can be performed in bed without any disturbance of the patient, without pain or shock, and in a very few minutes. The operative procedure he originally described need not be accompanied by shock. I am therefore forced to conclude that the time factor is of no great importance, while there are obvious objections to performing this or any operation in bed, especially if one eye is to be kept on the clock. None of my patients has been obviously shocked by the operation; many of them have slept throughout the whole operative procedure; and some, a few hours afterwards, have been unaware that anything had been done.

Abstract of the Method

Probably by this date most operators using the Smith-Petersen nail have already developed their own technique. This will be determined by the limitations of the surgeon, the place of operation, and, to some extent, by the condition and age of the patient. In my opinion a portable x-ray apparatus is essential, an orthopaedic table desirable, and expert assistance valuable. A spinal anaesthetic has been used in all the cases and has proved satisfactory.

WHEN TO OPERATE

My patients have been operated on as soon as convenient after their admission to hospital. Some of them had already undergone other forms of treatment, but most had had no treatment at all. In twenty-four cases the interval between date of fracture and date of operation was stated in the notes. The shortest interval was four

days and the longest sixteen months, the average in the cases treated being just over nine weeks. Nearly all the failures were included in the long-delayed operations, as might be expected. In the absence of early complications I regard a week after receipt of the injury as the ideal time for operation. I am not quite so sanguine as Brittain, who holds that *all* the grave complications and sequelae which follow fracture of the femoral neck in the aged may be prevented by the early introduction of the nail.

THE ANAESTHETIC

The patient is given a quarter of a grain of morphine half an hour before the time fixed for the operation. To avoid the pain and shock of moving him before inducing anaesthesia, the bed is wheeled to the theatre. The patient is gently turned upon his sound side, his back brought to the edge of the bed and arched by strongly flexing the sound limb. A local anaesthetic is injected between the third and fourth lumbar spinous processes, and this is followed by an intraspinal injection of 2.5 c.cm. of decicaine. Immediately after the injection the foot of the bed is elevated to an angle of 15 degrees with the horizontal and kept in this position for fifteen minutes. Then for five minutes the patient is turned flat on his face, the feet still being kept raised. In every case there has by this time been good anaesthesia, which has lasted throughout the operation, and there has been no subsequent complaint of headache. The patient is then rolled on to the Hawley table on his back, and the sound foot bandaged in internal rotation to the footpiece with the limb in moderate traction.

REDUCTION OF THE DISPLACEMENT

In all the recent cases I have used the Leadbetter method, modified only by the application of outward traction to the upper end of the femoral shaft during flexion and internal rotation. After reduction the foot on the injured side is bandaged to the footpiece in strong internal rotation, traction, and moderate abduction. The limbs are thus symmetrically placed, and it will be found that the great trochanters are equidistant from the table and the ilio-tibial bands of equal tension on the two sides. I have found measurements of no value at this stage.

POSITION OF THE FEMORAL NECK

The various anatomical landmarks in the neighbourhood of the hip-joint are now identified: the anterior superior spine, the pubic spine, Poupart's ligament, the line of the femoral artery (we have found this variable in our cases), and the line of the femoral shaft. Having determined these by palpation, the situation of the femoral head and line of neck can be inferred. The Hey Groves angle-piece is strapped by adhesive plaster on the front of the joint as directed by its author. A guide wire is placed over the assumed position of the femoral neck and under the angle-piece. It, too, is fixed by adhesive plaster. The first x-ray film is now taken and rapidly developed. The film will show whether reduction has been complete and, by comparing it with the angle-piece and guide still fixed to the front of the hip, we are able to determine accurately: (1) the centre of the head; (2) the point where the axes of the neck and shaft intersect. The accurate determination of these two points is the crux of the whole operation. It is made difficult in fat patients by a pendulous abdominal wall overlying Poupart's ligament, and by the fact that in some cases the femoral artery overlies the centre of the femoral head. When the points have been finally decided upon they are marked on the skin by crosses, using a sharp needle for the purpose, and the angle-piece,

guide wire, and strapping are removed. All these steps have been of a preliminary nature. Now the surgeon, his assistants, and the parts are prepared for the operative procedures.

The Hey Groves Guide

The spikes of the Hey Groves apparatus, adjusted to the required interval, are introduced through punctures made in the position of the crosses and pushed down firmly upon the underlying bone. This brings the carrier of the guide against the skin on the outer side of the thigh and indicates the position of the incision, which is deepened down to the outer surface of the femur. The carrier is pushed into the wound until it meets with the bone, and through the carrier passes the guide wire. This is of the rigid type suggested by Watson-Jones—a matter of some importance, for it allows the point to be driven into the bone by a few strokes of the hammer before the drill is attached. This manœuvre prevents the point from slipping upwards along the shaft of the femur. The drill is now attached to the guide and the bone drilled. This guide is six inches long and passes inwards until at least half of it is buried. This ensures that it has engaged the head of the bone. The second x-ray film—an antero-posterior one—is now taken. With increasing confidence in the Hey Groves apparatus we have abandoned the former practice of taking a lateral film at this stage. This film shows whether the guide occupies the centre of the neck, the length of nail required, and the relative position of the flanges if the position is not quite central.

The length of nail will be determined by the position of the point of the guide in relation to the head of the bone and the length of the guide buried, keeping in mind the amount of distraction of the fragments. We have found that nails of three and a quarter and three and a half inches are most often used. An absolutely central nail may be slightly longer than one that is eccentric, and will therefore be more effective in maintaining fixation. It must also be decided at this stage whether the position is good enough or whether a second guide must be introduced. This is usually a simple matter with the first still in position.

Trusting to the analogy that valgus positions of the head often resulted in sound union and good function without treatment, the view was at first held that low insertion of the nail leading to upward tilting of the head was beneficial rather than otherwise. This, however, cannot be maintained owing to the tendency for such cases to develop arthritis.

It now only remains for the nail to be threaded on the guide and driven into the bone. As soon as it has penetrated far enough to engage the head, and not before, the guide wire is withdrawn. The nail is then hammered inwards until its head comes in contact with the shaft of the femur. Traction on the foot must now be released. This has generally resulted in the nail head slipping outwards about a quarter of an inch owing to the distraction of the fragments being taken up. The punch is again applied to the head and the nail is finally driven in until its head again comes in contact with the shaft. A few more strokes will carry the upper end of the shaft and nail together against the proximal fragment, producing the required amount of impaction.

If the operation has been successful in obtaining secure attachment of the head of the femur to the neck, this can be demonstrated by putting the joint through its normal movements with the fingers of one hand on the great trochanter. Further confirmation of the immediate result

must be obtained without possibility of mistake by x-ray films in the antero-posterior and lateral directions before the patient leaves the table.

After-treatment

The day after operation the patient is conscious of freedom from deep pain in the hip and soon obtains good control of the limb. He is kept in bed, but is allowed to sit up on a bed-rest. No retentive apparatus, apart from a pillow under the knee and a sandbag on the outer side of the foot, is necessary. Massage for the muscles of both limbs is used from the day after operation; movement is encouraged in all joints of both limbs—an important point, especially in elderly patients. Subsequent progress will depend on the age of the patient and on the interval between the dates of the fracture and the operation. Generally the patient is confined to bed for from six to eight weeks. Afterwards he sits out of bed on a chair and learns the use of crutches, often a difficult undertaking in an elderly stout person. In the younger patients restoration of function is rapid: progress will be accompanied by the development of callus, as shown by x-ray films. A lookout should be kept for new bone bridging the gap of the fracture and more especially along the under aspect of the neck in the situation of the calcar, as pointed out by Gissane. Older patients may progress slowly, three to six months elapsing before they can take the full weight of the body on the limb without pain and being able to discard the aid of crutch or stick.

General Results

It is possible by means of the technique described above to obtain immediate firm fixation of the broken fragments in good position with complete relief of symptoms. Let us try to find out what is the ultimate fate of such cases.

The present relatively small series of thirty-three unselected and consecutive cases covers a period of just over three years. It includes all the patients in whom I have used, or tried to use, the Smith-Petersen nail by a closed type of operation. In the three earliest cases the nails were introduced blindly with the assistance only of one pre-operative antero-posterior x-ray picture. In the next four cases a fine Kirschner wire was used as the guide, and in one of these, owing to the buckling of the wire at the seat of the fracture, the nail had to be extracted on the table, and it was found impossible to remove the wire at all. In twenty-six cases the Watson-Jones guide and the Hey Groves apparatus have been used, to our entire satisfaction. No wound or deep sepsis occurred in any of the cases.

There have been thirty-seven operations performed on the thirty-three patients. One patient had a second operation for reinsertion of the nail, and remains a failure; one patient who had a second operation for reinsertion and a third for its removal has obtained bony union; one whose nail came out had it replaced by an autogenous bone graft at a second operation, and the bones have remained ununited. A review of results in these cases has been greatly assisted, indeed made possible, by the kind help of my colleague, Mr. R. J. McConnell, who has produced a film of the results in twenty-two patients out of twenty-four who obtained bony union. Of the other two patients who obtained bony union, one, a man, died from pneumonia after enjoying good use of his limb for a year; the other, a woman, developed mental symptoms and, though getting about in her own house without pain and under supervision, could not be persuaded to submit to the photographer's art!

By means of the film it has been possible to judge of the functional results after seeing the patients use their lower limbs in sitting, standing, walking, running, going up and down stairs, etc. On analysing the results we find that of the thirty-three cases operated on one patient died, in seven for various reasons the fragments had not united, one was too recent to form an opinion, and in twenty-four bony union took place. Of the twenty-four patients with bony union twenty-two have been "filmed." Excluding the patient who died four days after operation, the patient in whom the nail was never inserted, and the one too recent, there are twenty-four bony unions out of thirty patients who had the nail inserted and who lived long enough for bony union to occur—80 per cent.

Answers will here be sought to the following questions: (1) What is the mortality rate of the operation, immediate and remote? (2) How many patients as the result of treatment obtained bony union? (3) What is the resulting function in those cases showing bony union? (4) How many patients suffer from pain? May this be taken as a sign of incipient arthritis of the degenerative type?

The Mortality Rate

A review made three years after the first operation showed that already four patients out of thirty-three are dead. The following are the details:

(a) A woman aged 52 years died on the fourth day as the result of coronary embolism—the only death directly due to operation; the patient was the youngest but one of the series.

(b) A man aged 66 died of pneumonia one year after operation (January 14, 1936). He had firm bony union and good painless function, and the result was often demonstrated to students at hospital during the year following operation.

(c) A woman aged 70 died of diabetes (operation on March 23, 1937) twelve months after operation (united)—"a troublesome old lady." Seven days after operation, and many times on subsequent days, she got out of bed without apparent harm to the position of the nail: in the end the nail was extruded and displacement of the fragments recurred.

(d) A woman aged 83 (operation on August 31, 1937) died nine months after operation at the infirmary. The cause of death was unknown.

Proportion of Cases Resulting in Bony Union

The second question is probably the most important one, the general answer to which will decide the fate of the method of treatment which has been adopted. The evidence upon which the presence of bony union can be vouched for is threefold: (a) Clinical examination of the hip-joint should show painless normal movements—that is, rotation of the limb around the axis of the head, the absence of telescoping at the hip, and the absence of crepitus in carrying out these movements. (b) X-ray appearance of new bone bridging across the gap of the fracture and the development of lines of stress, especially in the position of the calcar femorale. (c) Good function in the shape of painless weight-bearing and the absence of limp when the patient walks.

Applying these tests, we find them satisfied in twenty-four out of the thirty-three patients. Excluding one patient too recently operated on, success was therefore obtained in twenty-four out of thirty-two operations. If one patient be excluded owing to death on the fourth day and another as not having the nail introduced at all, we find that insertion of the nail has resulted in twenty-four obtaining bony union out of thirty—that is, 80 per cent.

Let us consider further the seven patients who for various reasons have failed to obtain bony union. Five

of these were among the earlier cases before the operative technique had been perfected. What are the causes of failure?

1. Failure (operation August 7, 1936) in a man aged 71 was due to complete breakdown of operative technique. A Kirschner wire was used as a guide. It buckled at the site of fracture when the nail was being introduced, forming an S-shaped bend at this level. This was discovered by noting that the guide was being carried in by the nail and was then demonstrated by an x-ray film. With great difficulty the nail was withdrawn, but the Kirschner wire could not be withdrawn at all. Non-union is therefore not attributable to the nail but to failure in the method of introduction.

2. Failure in a woman aged 69 (operation August 12, 1936) was due to too early use in a subcapital fracture. The patient was sent to a convalescent home six weeks after an apparently good introduction of the nail. She returned a month later with the nail broken out through the upper part of the head. It seemed unlikely, owing to the small size of the head and owing to comminution, that further nailing would succeed, and therefore a bone graft was inserted, but this subsequently broke and the fracture remains ununited. Causes of failure were: (1) small upper fracture, and (2) too early movements of limb without proper supervision.

3. The third failure occurred in a woman aged 70, a diabetic (operation on March 23, 1937). The patient could not be prevented from getting out of bed. She did this on several occasions without apparently displacing the fragments. Eventually, however, some three months after operation, there was separation of fragments, and she died one year after incurring the fracture.

4. This failure occurred in a very frail old woman aged 83 (operation on August 31, 1937). She showed no evidence of new bone formation, and died in the infirmary nine months after operation.

5. Failure in a woman aged 80 (operation on December 21, 1937), a very fit old countrywoman, with a fracture in the middle of the femoral neck of eleven weeks' duration. The nail was in a good position. She was kept in hospital for three months, but was out of bed for several weeks before leaving. X-ray films showed no sign of bony union, but there were progressively developing lines of sclerosis on each side of the fracture. She was found out of bed by her relatives and in pain. The fracture had recurred, and the nail was replaced on March 21, 1938. The result was a real failure of the method in a case late in the series in which union was confidently expected.

6. Failure in a woman aged 60 (operation on January 25, 1938): fracture eighteen months old. There was pseudarthrosis, with absorption of neck. A poor position was obtained at the operation. The fragments could not be approximated so as to fit together. There was a possibility of soft tissue between. No union had occurred after six months.

7. Failure in a woman aged 51 (operation on April 6, 1937): a six-weeks fracture with poor approximation of fragments. She was a difficult patient who refused to be controlled: the nail gradually slipped out, and ultimately broke loose from the proximal fragment.

Summarizing the failures, it may be stated that in one patient the nail was never introduced at all; one was a diabetic who showed no new bone formation; one was an almost bedridden old woman of 83 years; in one the fracture was eighteen months old and there was a pseudarthrosis; one, aged 80, showed sclerosis on both sides of the fracture, though in good position; and one had poor approximation of the fragments with the possibility of soft tissue between.

Resulting Function in Cases with Bony Union

Of the twenty-four patients in whom bony union was obtained twenty-two were induced to present themselves

for the purpose of being filmed. These were put through a series of tests, including walking up and down half a dozen stone steps, putting the feet up alternately on an ordinary chair, sitting on a chair and standing up several times, lifting objects off the floor, etc. Before their visit some of the patients had never done anything beyond walking on level ground, and they were obviously suffering from an attack of "nerves" as they faced the camera. The performance of those who had had prolonged treatment by massage was much better than that of those who on leaving hospital were thrown on their own or their friends' resources. The younger patients, other things being equal, were superior in performance to the older ones, and their functional recovery was surprisingly rapid. The youngest patient in the series was a man aged 43. He left hospital five weeks after operation, with crutches, but admitted that he never used them. He began work as a builder's labourer five months after operation, and had carried a hod of bricks up a ladder. For the camera he sat on his heels, touched his toes with his knees straight, ran upstairs, and performed every kind of movement without halt or impediment. An old lady aged 82 has no limp in walking or running, can bend down to her toes, and can tie either shoe: even when she runs it is impossible to tell which hip was broken.

Only one of the twenty-four patients complained of pain: she was aged 61 at the time of the operation, had the femoral head tilted into the valgus position by the nail, and is getting arthritis. The head shows sclerosis under the articular cartilage. In seventeen patients the tests were so well carried out that the function was considered good. By that is meant: (1) they had no pain; (2) it was almost impossible to tell which hip had been broken unless they hurried; (3) they had been carrying out their ordinary occupations—mostly housework in women: of the men one was a solicitor and another a labourer (who has also a fracture of the os calcis on the same side). This patient was in the Royal Victoria Hospital during the B.M.A. meeting of 1937, and was seen by several surgeons.

In three cases the function was classed moderate. These had an easily recognizable limp, though they did not complain of pain. One of them was a timber merchant, who supervised loading in a timber yard from four months after operation. He had a valgus position of the head, some sclerosis, and commencing arthritis. One was a patient who had the nail replaced after it broke out. On the second occasion the nail was intentionally driven into the acetabulum. She now (eighteen months after the second operation, the nail being removed) has bony union, painless weight-bearing, shortening of the neck, and will probably eventually develop arthritis. The third patient was operated on fourteen months after the fracture, and then had well-marked decalcification of the head and the great trochanter. She now (two years after operation) has bony union with a shortened neck and some coxa vara, and the whole upper extremity of the bone is still poorly calcified.

Two others have poor function, though the bony union is sound. They have an obvious limp and insist on using a stick. One has a valgus position of the head with partial sclerosis and evidence of commencing arthritis. The other is a woman weighing sixteen stone; the fracture occurred fifteen weeks before operation. There was a good deal of absorption of the neck, but she now has bony union. Since leaving hospital over a year ago this patient has taken practically no exercise, sitting on a chair all day. She came up using two sticks, but can walk quite well without any such assistance; on level ground she can walk slowly without a noticeable limp.

THE QUESTION OF PAIN

Only one of the twenty-four patients showing bony union complains of pain. She has a valgus position of the head, a certain amount of sclerosis of the head, and is developing a degenerative arthritis. She was operated on twenty months ago, and her gait is deteriorating as her pain is increasing.

Arthritis.—Radiologically three patients appear to be developing arthritis—the one already mentioned, who is a woman, and two others, who are men. One of these men, aged 55, walks slowly without limp and says he has no pain; his operation was performed in a country hospital "on the blind," with the assistance of one antero-posterior photograph and no apparatus or special table. His nail was removed twenty-four months after operation, and six months later he climbed a hill of 500 feet without trouble or subsequent pain. His range of movement is still good. The other is aged 57. He was operated on two years ago; is getting restriction in his movements, especially abduction; has a valgus position of the head; and had the nail removed a month ago lest his arthritis might be due to its presence.

Conclusions

1. The Smith-Petersen nail introduced by the method of Hey Groves is suitable for the treatment of the great majority of cases of fracture of the neck of the femur admitted to a general hospital.
2. Of all the patients operated on, bony union may be expected in over 70 per cent. Of those in whom a nail has been successfully introduced, and who live long enough, bony union may be expected in 80 per cent.
3. Of the patients obtaining bony union almost all will have painless weight-bearing, while 50 per cent. will have almost perfect function.
4. A few will have poor function, due to arthritis, absorption of neck, coxa vara, and defective calcification of the fragments.

Summary

The paper deals with thirty-three patients suffering from fracture of the neck of the femur. In these, thirty-seven operations have been performed for introduction of the Smith-Petersen three-flanged nail by a closed method.

It discusses the suitability of patients for this form of treatment, the method of operation employed, and immediate and remote results obtained on review after three years.

It gives the mortality, immediate and remote, and the number of patients in whom bony union was obtained, with details of the failures.

Immediately after the insertion of the nail the patient obtains complete relief from pain, good control of the limb, and, beyond confinement to bed, suffers from no disability.

The final functional results were demonstrated by a film showing twenty-two of the patients.

At the annual meeting of the British Association for the Advancement of Science, to be held this year in Dundee from August 30 to September 6, under the presidency of Sir Albert Seward, F.R.S., the Section of Chemistry will be presided over by Professor E. K. Rideal, F.R.S., the Section of Anthropology by Professor W. E. Le Gros Clark, F.R.S., F.R.C.S., the Section of Physiology by Professor David Burns, and the Section of Psychology by Mr. R. J. Bartlett.

TUBERCULOSIS—DOGMAS AND DOUBTS
OF SIXTY YEARS

BY

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During the course of my training and my period of thirty-seven years as medical officer of health accepted views have varied, and some of the explanations given from time to time have not appeared to accord with experience, raising doubts in my mind as to their correctness. With a view to resolving these doubts I kept records in the hope that opportunity would arise for summarizing the results. This has been done in the following notes from various books and papers and over 200 references.

In Wynter Blyth's *Dictionary of Hygiene and Public Health* (1876), published thirteen years before I registered as a medical student, occurs the following description: "Although there are differences between phthisis, consumption, and tuberculosis, they are only such as have been pointed out of late years by a more accurate and extended pathology; hence it will be convenient for the study of consumption statistics to define, for the purposes of this article, the term 'phthisis' as a disease of the lungs attended by wasting . . . and signified by others as consumption, dry-rot, etc." It was suggested that in certain instances phthisis would appear to be contagious, especially in crowded barracks and such-like places. It was considered that hereditary influence had been much exaggerated, and it is said: "that impure air alone will produce consumption, the excessive mortality of soldiers in certain barracks . . . sufficiently proves." Damp soil, unhealthy trades, tight clothing, etc., are also given among the causes.

Already bacteriology had been born and the microbic causes of a few diseases were known. Within six years of the publication of the above note Koch reported his discovery of the tubercle bacillus. Even so, the new idea was not readily accepted in all quarters, and indeed it was described by some as "simple nonsense—utter humbug" (Philip, 1932). As late as 1893, in the textbook on which I was educated—Frederick Taylor's *Practice of Medicine*—the cautious description reads: "Recent researches on the bacillus of tuberculosis tend strongly to the view of the unity of phthisis—that is, to the belief that all forms of destruction of the lung commonly known as phthisis are due to the invasion of this bacillus, and are tubercular in nature." Later it is said: "Nothing seems to be better established than the truth of the hereditary transmission of phthisis." A common phrase in use about this time was "tubercular diathesis," to which greater importance appeared to be attached than to infection with an organism. As regards lupus, Taylor says: "Nevertheless, there is an increasing tendency to regard the tubercle bacillus as the cause of lupus."

At that time there seems to have been no suggestion of more than one kind of tubercle bacillus: in the *Manual of Bacteriology* (Muir and Ritchie, 1897) the following phrase appears: "There can be no doubt that the bacilli present in tuberculosis of the various mammals mentioned are of the same variety, though differences in virulence may be occasionally noticed. There has, however, of late years been considerable discussion as regards the identity of the bacilli in avian and mammalian tuberculosis."

Dr. B. Arthur Whitelegge (1899) says: "There is still much doubt as to the frequency of direct infection from person to person but none as to its occasional occurrence or as to the fact that almost all persons must frequently inhale and swallow living *Bacilli tuberculosis*."

Dr. Theodore Shennan (1908) observes: "In the causation of the disease one must bear in mind two factors, the soil and the germ. In the absorbing discussions which