ARTHRODESIS OF THE OSTEOARTHRITIC HIP JOINT

SIR REGINALD WATSON-JONES and WALTER C. ROBINSON, LONDON, ENGLAND

Degenerative osteoarthritis limited to one joint occurs more commonly in the hip than in any other joint because the femoral head is susceptible to both anatomical and physiological defects—to structural deformity of the bone and also to impairment of the blood supply. Congenital subluxation, developmental dysplasia, deficiency disease, endocrine disorder, fracture, epiphysial separation and dislocation of the joint, all may give rise to coxa plana, coxa vara, coxa valga, coxa magna or other incongruities in the shape of the articulating bones; while at the same time the vascular supply through blood vessels of the capsule and ligamentum teres is so precarious that avascular necrosis, osteochondritis and degeneration of articular cartilage may arise. It is not intended in this contribution to discuss the pathology of erosion of articular cartilage, the formation of osteophytes, thickening of the inferior aspect of the femoral neck, changes in bone texture, or the development of cysts in the femoral head and roof of the acetabulum, or to consider whether these changes arise from ischaemia or hyperaemia. That is another study. It is proposed only to remind ourselves that these degenerative changes occur very commonly in middle life at the ages of thirty to sixty years in one hip joint alone without general involvement of other joints or even of the opposite hip, and to consider the treatment of such degenerative changes by arthrodesis.

The first reason for choosing a simple clinical study of arthrodesis of the hip for the Thomas Fairbank Birthday Volume is that so much of the life of this great surgeon was devoted to clinical study of the problems of congenital dysplasia of the hip joint which without good early treatment causes degenerative osteoarthritis at the age of about thirty to thirty-five years.

The second reason for reviewing patients treated by arthrodesis of the hip joint after an interval of five to twenty-five years from the time of operation is that recent discussions and contributions have suggested a degree of despair and despondency that seemed surprising. We had thought that no orthopaedic operation was more gratifying to the patient, more satisfying to the surgeon, or more certain of restoring function; and yet it is being said that it is an operation of great technical difficulty, that it is unreliable, and that we cannot be sure of gaining sound fusion. It is said moreover that even if fusion is sound there will nearly always be pain in the back, often painful stiffness of the knee, and usually difficulty in sitting.

Consider for example these quotations from recent surgical literature: "bony union is difficult and doubtful"; "bone fusion is not easy to achieve"; "thirty-three arthrodeses were attempted and only thirteen were satisfactory"; "the first attempt to repair pseudarthrosis of the hip resulted in 50 per cent of failure"; "it is very difficult to ensure solid fusion"; "this arthrodesis shows a strong tendency to fibrous union"; "the pseudarthrosis rate for the entire group was 23 per cent"; "the mortality rate was 3-4 per cent and the rate of infection was 6 per cent"; "combining delayed union and failure gives 43 per cent of cases not proceeding entirely as the surgeon would wish"; "one failure for every two fusions is not a good recommendation for any operation."

As if that did not sound bad enough by reason of serious failure in the primary purpose of the operation we must go on to quote: "all of us are disturbed by the difficult problem of the stiff knee following many months of immobilisation"; "prolonged immobilisation in plaster-of-Paris causes stiffness of the knee"; "apart from failure of osseous union the main disadvantage is painful stiffness of the knee"; "we only used a short spica because we feared knee stiffness"; "there is danger of permanent stiffness of the knee and prolonged pain in the knee."
Then, lest we were not already frightened, we read: "when the hip is fused, excessive strain is thrown on the lumbar spine"; "patients complained of back pain when lying in bed unless a pillow was placed under the knee on the involved side"; "back pain was present in all age groups following arthrodesis" (Stinchfield and Cavallaro 1950, Taylor 1950, Howard 1950, Osmond-Clarke 1950, Smith-Petersen 1950, Judet 1950, Law 1952, Charnley 1953, Apley and Denham 1955, and others).

Many of these observations have no doubt been quoted from one paper to another on the basis of rumour alone without personal confirmation. In fact, the most acid critics of arthrodesis of the hip joint are those who never do it. Nevertheless the criticisms have been repeated with such frequency that one of us (W. C. R.) undertook a late follow-up of every arthrodesis of the hip joint done by the other (R. W.-J.). This independent study confirmed former impressions. It proved that fusion of the osteoarthritic hip can be relied upon with near certainty. Far from there being one failure in every two fusions there was sound bone fusion confirmed radiographically in 94 per cent, a mortality rate of nil, and a recovery of painless knee movement to the right angle or far beyond in 91 per cent of patients.

Analysis of the results of arthrodesis of the hip joint—At first it may seem surprising that one surgeon can report successful bone fusion in 94 per cent of patients whereas another refers to failure in 23 per cent (Stinchfield 1950), one to failure in 43 per cent (Charnley 1953), and another to failure of one in every two fusions (Apley 1955)—but these observations are misleading. The comments of Charnley, Apley and others misrepresent the statistical study of Stinchfield and Cavallaro (1950) which was a conglomerate of many different types of operation performed by many different surgeons for many different disorders of the hip. They reported on 117 patients treated by what was called "arthrodesis of the joint" by colleagues, associates and house-officers, including such varied procedures as Hibbs' extra-articular with trochanteric graft, attempted fusion with an iliac graft but no internal fixation, intra-articular fusion with or without straight nails, ischio-femoral grafting of the Brittain type, nail fixation alone without exposing the joint, and "an insufficient number of other types of arthrodeses to be of statistical value." There were failures in from one-quarter to one-half of the cases. But many of these operations were archaic and of no more than historic interest; many were of a type that are now known to be useless; some were of the standard known to be essential. Why then should such a mixed review be quoted as the results of arthrodesis of the hip as we understand it today?

The series of patients reviewed in this contribution had arthrodesis of the hip joint by one surgeon who did the operation himself and supervised the after-treatment himself. It seemed better to exclude the many hundreds of other arthrodeses of the hip done at the London Hospital, the Robert Jones and Agnes Hunt Orthopaedic Hospital, the Liverpool Royal Infirmary, and the Royal Air Force Hospitals by colleagues or associates, with no more than a relatively remote control. This is an attempt to assess the results that are possible from one standard type of arthrodesis in the hands of one surgeon who himself is responsible from the beginning to the end.

Unfortunately the records of more than sixty patients were lost in the fire that destroyed the Robert Jones and Agnes Hunt Orthopaedic Hospital in 1948. We have also failed to trace a few others. Thus there remain 141 patients treated by arthrodesis of the hip joint who have been followed up at regular intervals, with a review of the result as confirmed five years and up to twenty-five years from the date of operation, the average period being eleven years. More recent cases have been excluded because a follow-up of at least five years is essential. We need only look at the results of nail fixation alone to realise that many patients gain relief for two or three years but with unfortunate failure later on. Indeed one patient treated by nail fixation was comfortable for ten years and only then had serious trouble. We should also look at the results of arthroplasty by prosthetic replacement of the upper end of the femur which were reported upon enthusiastically after two or three years but caused
grave despondency thereafter. No operation such as the Brittain V-arthrodesis with nail and graft, McMurray osteotomy, Girdlestone excision of head and neck of the femur, excision of upper end of the femur with Batchelor osteotomy, central displacement by the Charnley technique, or prosthetic replacement of the femoral head as advised by Judet, should be considered as proved in success unless the follow-up of results is from at least five to twenty or more years.

In reaffirming that sound bone fusion was proved in 94 per cent of cases by clinical tests and confirmed by radiographic examination it must at once be said that this relates only to patients with osteoarthritis treated by the standard operation of denuding and refreshing the joint surfaces together with the internal fixation of a nail, perhaps also of a graft, with the external support of a double plaster spica of full length for several months and certainly not less than four months.* Of these 120 patients there was need in four for a second operation after failure of the first. Similarly after open reduction for old traumatic dislocation with attempted arthrodesis, one of the two successful fusions was gained only

| TABLE 1 |
|------------------------|------------------------|
| **Results of Simple Fixation of the Hip by Nail, Intra-articular Arthrodesis of the Hip, and Operative Replacement of Unreduced Dislocation of the Hip** |
| (141 patients) |
| *Fixation of the osteoarthritic hip by nail only (14 patients)* | |
| Sound bony ankylosis | . | . | . | . | 1 |
| Fibrous fixation—relief for ten years | . | . | . | . | 1 |
| Fibrous fixation—temporary relief | . | . | . | . | 11 |
| Died | . | . | . | . | 1 |
| **Intra-articular arthrodesis of the osteoarthritic hip usually with both nail and iliac graft (120 patients)** | |
| Sound bony ankylosis | . | . | . | . | 113 |
| Unsound union—failed | . | . | . | . | 7 |
| Died | . | . | . | . | nil |
| Degenerative osteoarthritis | . | . | . | . | 102 | Failed | 7 |
| Congenital dislocation | . | . | . | . | 11 | Failed nil |
| Ununited McMurray osteotomy | . | . | . | . | 3 | Failed nil |
| Failed cup arthroplasty | . | . | . | . | 4 | Failed nil |
| **Open reduction of old traumatic dislocation of the hip with attempted arthrodesis (7 patients)** | |
| Sound bone ankylosis | . | . | . | . | 2 |
| Unsound—failed | . | . | . | . | 3 |
| Died | . | . | . | . | 2 |

after a second operation, the first having failed. Unlike the view taken by Stinchfield in his reports we think that these should be classified as successful results and not as failures. It may be added that all these five patients with unsound fusion from the first operation gained sound union of the arthrodesis from a second operation after the grafting of cancellous iliac bone: there was certainly not failure in 50 per cent, as has been reported in other articles. *Fixation by nail alone*—Two other small groups of cases must be considered separately. First, there are fourteen elderly patients who were treated many years ago by the insertion of a nail alone, the joint never being exposed. This operation, which has long since been abandoned, was not expected to fuse the joint. If sound bone ankylosis is to be considered the standard of success these cases represent a failure of nearly 100 per cent. But obviously they should not be included in a statistical review of arthrodesis of the hip, as Stinchfield did, because the operation was never expected to be an arthrodesis. *Operative reduction of old traumatic dislocation of the hip*—The second group to be considered separately are patients with traumatic dislocation of the hip joint, unreduced after many

* This review includes only patients with osteoarthritis of the hip joint of congenital, developmental, traumatic or paralytic origin, and none with tuberculous or acute suppurative arthritis.
months or years, where the essential measure was late operative replacement. Any attempt to secure fusion of the joint at the end of such an operation must surely be regarded as a supplementary procedure. In fact, the results in this small group of seven patients were so bad as to dissuade most surgeons from attempting operative reduction of old traumatic dislocations. Of seven patients so treated, two died, three developed pseudarthrosis, and only two gained sound fusion, one from a second operation after failure of the first. If these are to be included in the results of arthrodesis of the hip they show success in only 28 per cent, and failure in 72 per cent. Such failures are not however representative of the results of arthrodesis of the hip for degenerative osteoarthritis, congenital subluxation, epiphysial coxa vara, old Legg-Perthes' disease or paralytic subluxation.

**FIXATION OF THE OSTEOARTHritic HIP BY NAIL ALONE**

Nearly twenty years ago there was recorded an attempt made in elderly patients with osteoarthritis to fix the hip by the insertion of a nail from below the trochanter without exposing the joint (Watson-Jones 1938). The idea was that patients aged from sixty to eighty years who might not withstand the risks of an open intra-articular arthrodesis could perhaps be relieved of pain by the simple fixation of a nail, supplemented at first by a short plaster spica. We are sorry that this operation was ever recorded. It should have been obvious from the beginning that nail fixation alone could never sustain firm and sound fixation. Sooner or later, in consequence of the tremendous strains and forces that are concentrated at this level, there was bound to be resorption of bone with gradual loosening of the nail. Of the fourteen patients so treated, only one who had arthritis of a rheumatoid type gained sound ankylosis. One other, whose joint was already almost completely stiff at the time of the nailing, had relief for as long as ten years (Fig. 1) but even he had recurrence of severe pain after that—which shows how useless it is to assess the end-results of such operations after a follow-up period of only two or three years. In eleven there was temporary relief of pain lasting for a year or two but not longer. One died from fat embolism.

The ages of these patients ranged from sixty to seventy-six years. On late review it is obvious that the benefit from nailing alone was short-lived and that the procedure was hardly worth while. We have long since abandoned the operation. Unfortunately however it is more difficult to withdraw a recommendation than to propose it, and in various parts of the world bigger and better nails, stronger bolts, and more powerful screws and plates are still being used in an endeavour to fix the hip by an extra-articular method relying upon metal alone. They will all fail. Many patients of this age are of course too feeble and fragile to put up with the rigours of intra-articular arthrodesis with prolonged immobilisation in plaster. It is very possible that in this age group the Charnley operation of central displacement of the femoral head will find its right application. Certainly there is no merit in trying to fix the hip joint by a nail without intra-articular fusion, no matter how powerful the nail may be nor how strong the screws and bolts attached to it may be.

In acknowledging that a nail alone cannot permanently fix the hip we must also recognise that even after open exposure of the joint with complete denuding of articular cartilage, internal fixation, and the support of a plaster spica for several months, the nail itself cannot protect unsound consolidation. If the joint is not already soundly fused the nail will gradually loosen from resorption of bone wherever there are compression forces. The degree of such compression, and strength of the rotational forces, may be judged from the patient whose radiographs are shown in Figure 2. This girl had residual paralysis from poliomyelitis. A difficult decision had to be taken as to whether she might be improved by arthrodesis of the hip. It was decided, perhaps foolishly, to try the temporary insertion of a nail by which to assess function after stiffening the hip with the intention of withdrawing the nail without too much damage if the patient was made worse, but going on to formal arthrodesis if she was made better. This case is quoted only to show how great are the stresses at a stiffened
hip joint. Within a week or two of the trial operation and attempted weight bearing the joint was distracted and a heavy steel nail was twisted through 45 degrees. These are the forces with which we must contend.*

![Image](image-url)

**Fig. 1**

This is the only patient who gained more than temporary relief from simple nail fixation of a painful osteoarthritic hip, his joint having already been almost completely stiff. He was happy for ten years—but let it be noted that as long as ten years was needed to determine the real end-result. We must not judge the results of operations on osteoarthritic hip joints from two or three year follow-up studies. Five to twenty or more years are needed to judge the end-result.

Look now at Figure 3. Here is a patient whose hip joint had been arthrodesed by one of our colleagues in Liverpool with full exposure of the joint, denuding the articular cartilage, and internal fixation by a three-flanged nail with protection in a plaster spica for three months. It was then thought that although the fusion was not quite sound it would be enough to rely upon the well placed nail for consolidation to be completed. Far from this being so, the unsound union became less sound, the fibrous fixation became less firm, mobility increased, and as months went by the pressure-resorption of bone permitted a range of movement of almost 90 degrees, the nail lying loose both in the pelvis and in the femoral neck (Fig. 3).

**INTRA-ARTICULAR ARTHRODESIS OF THE OSTEOARTHRITIC HIP WITH NAILING AND GRAFTING**

Before considering the results of intra-articular arthrodesis of the hip joint as reported in this series we must first discuss the indications that were insisted upon before the operation.

* With considerable difficulty the twisted nail was removed and the joint was arthrodesed. Since then she has done well. The Trendelenburg limp and lurch was entirely controlled and her function was greatly improved. We regret only that we bothered her with the "trial nail fixation" which gave a lot of unnecessary pain and discomfort.
FIG. 3
Even after intra-articular arthrodesis and support in plaster for three or more months a nail does not suffice to protect unsound fusion, as proved in this case treated by one of our colleagues in Liverpool where a tremendous range of mobility developed. It was thought that early union might proceed to final consolidation by the protection of the nail—but see what happened.
A nail can never be more than an internal suture.
was done. It should be emphasised that no patient was ever persuaded against his will. Not until it is quite certain that the degree of disability, and the severity of pain and stiffness, really warrants it should the hip be arthrodesed. This series of 141 patients is from a total of many hundreds of others with osteoarthritis of the hip joint who were advised that although fusion might be needed one day they were for the moment much too good for it. Many had pain and limitation of activity but still with about 90 degrees of movement and an ability to walk several miles, perhaps with a stick. They needed no more than reassurance. Many were worried and anxious because having been told that they had arthritis they feared crippling, invalidism and a bath-chair life. For them the essential treatment was reassurance that the “arthritis” was no more than a simple age change just like a hinge in a door which had begun to creak and squeak, and that it had nothing whatever to do with rheumatoid arthritis or any crippling disorder. Palliative measures such as massage, electrical heat, injection of lactic acid, the use of cortisone preparations, or irradiation of the joint may satisfy them that something is being done; but we think on the whole that it is better not to mislead patients by suggesting these measures which can never give permanent relief and are only temporary palliatives. If they want pain to be soothed by massage they can just as well rub the joint themselves without travelling long distances to departments of physical medicine. If they find that discomfort is relieved by heat they can just as well do it for themselves by a hot water bottle as by short-wave diathermy. The benefit of injection of lactic acid, hydrocortone, or other preparations have never been proved. The essential measure is to reassure the patient, advise the simple use of salicylates such as Aspin, Disprin, or Veganin and to be told that if, as years go by, there is increasing pain and stiffness the symptoms can always be controlled by a stabilising operation.

When pain and stiffness of the hip joint becomes so disabling that there is difficulty in walking more than a few hundred yards, or at the most a mile, arthrodesis should be advised. An important practical point at once arises. If it is put to the patient that the operation will be a stiffening procedure it is more than likely that it will be refused. He says to himself “the joint is very stiff now; what will it be like when he has finished with it?” It should not be put as a stiffening operation but rather that it is a stabilising operation. It should be explained that after successful fusion there will still be a range of movement that looks and feels like hip movement up to 30 or 40 degrees in every direction. The range of apparent movement, which of course is pelvic movement, should be demonstrated, it then being explained that with such mobility there will be every facility in walking without an appreciable limp, sitting comfortably, climbing, running, jumping, and indeed pursuing every activity. Many patients still have apprehension in wondering how a stiffening or stabilising operation can permit such apparent mobility and energetic activity. They should meet other patients who have had an arthrodesis of the hip. Of all operations that may have to be suggested none is more difficult for the patient to understand than this. The fact of the matter is that those who have got over initial doubts and had their hip joints arthrodesed are the first to suggest that they would like to welcome others and show what comfort, relief of pain, restoration of usefulness and energetic activity is possible.

**Indications for intra-articular arthrodesis of the hip joint**—Intra-articular arthrodesis is not indicated unless there is: 1) considerable pain in the hip, thigh and knee; 2) movement restricted to about half of the normal range or less; 3) restriction of walking to about one mile or as little as a few hundred yards; 4) unilateral arthritis, the opposite hip having a normal range of movement including almost full internal rotation, limitation of which is of course the first sign of degenerative osteoarthritis; 5) free mobility of the knee joint on the side of the affected hip. The success of arthrodesis of one hip joint depends upon free mobility of the other. If there is osteoarthritis of both hips some type of arthroplasty, osteotomy, or other mobilising procedure is necessary; but if the opposite hip is normal there need be no hesitation in arthrodesing the affected one no matter whether the patient is aged forty,
fifty or even more than sixty years. Occasionally it may be wise to arthrode one hip joint even when there are early signs of arthritic change in the opposite hip in order that the joint that is more advanced in its degenerative change may become "the good joint" which will take all strains and thus protect the other.

Contra-indication of arthrodesis when the knee joint of the same limb is already stiff—We should be very cautious in advising arthrodesis of the hip joint when the knee on the same side is already stiff. Ability to walk well and sit comfortably after arthrodesis of the hip depends on free mobility of the knee joint of the same limb.

No contra-indication of arthrodesis of the hip by fear of low back pain—Pain in the low back, even when accompanied by radiographic evidence of spondylosis or degenerative arthritis of the intervertebral joints, is not necessarily a contra-indication to arthrodesis of the hip. It is very often said that fusion of the hip gives rise to pain in the low back, but this is quite untrue. If an arthritic hip joint is fused in the neutral position so that external rotation and adduction deformity are corrected low back pain is relieved. Quite unlike the observations so commonly made and reported in the literature, arthrodesis of the hip joint does not cause pain in the back. Low back pain arises from strain of the intervertebral joints from unsound fixation of a hip in a deformed position. When fixation of the hip is sound, and the deformities are corrected, such low back pain as there had been is made better and not worse.

Age of the patient in determining whether to arthrode the hip—Finally we must consider age. By far the greatest number now reported were aged from twenty to sixty years (ninety-nine patients—just over 81 per cent). It is obvious that there may be caution in advising such an operation for patients who are aged more than sixty years because many of them do not want to be able to walk ten or twenty miles, go mountaineering, climb ladders, or run and jump. They may well prefer a palliative procedure such as arthroplasty or osteotomy which gives them all they need, with ability to sit elegantly and comfortably. Nevertheless, the decision as to whether or not a hip joint should be arthrodesed must be based on the physiological age of the patient and not on the dictates of a calendar. Many men and women of sixty or more years are still energetic and athletic, and they do want to be able to walk unlimited distances, never considering whether to take a walking stick, always forgetting that they have any restriction of activity. In this series of 141 patients no less than twenty-eight were aged from sixty to eighty years (23 per cent of the series). We well remember the patient who sustained a fracture of the neck of the femur at the age of ninety-two who had never forgiven a doctor who thirty years earlier, when she was aged sixty-two, had said "you are too old for an operation."

Only seven patients were aged less than twenty years (5.8 per cent). It so happens that none were in the first decade where suppurative arthritis of infancy may best be dealt with by arthrodesis as recorded by Bryson (1948). In this particular series all seven patients were in adolescent years, their hip disability arising from congenital subluxation, paralysis of muscles, Legg-Perthes' disease, or deformity of the femoral head from fracture of the neck. We feel strongly that in these patients the benefits of arthrodesis should not be withheld just because they are young. Figure 15 shows the radiograph of the hip of a girl aged fifteen who two years before had sustained a fracture of the femoral neck. As so often happens when the neck of the femur is fractured in adolescent years there was avascular necrosis of the femoral head. It had been proposed to remove the nail, replace it with a graft from the fibula, and correct the apparent shortening of more than two inches by a femoral osteotomy. In giving this advice the surgeon had said that arthrodesis would surely be needed when the patient reached the age of about thirty years but proposed a palliative operation meanwhile. What benefit is conferred by changing a total cripple to half a cripple in the young years of life that matter most? Why not in such circumstances go at once to the arthrodesis of the joint that is inevitable?
TECHNIQUE OF INTRA-ARTICULAR ARTHRODESIS OF THE HIP JOINT

It must be admitted that arthrodesis of the hip joint is by no means an easy operation. There are technical difficulties; but with reasonable skill by the surgeon, and the care of a good anaesthetist who may sometimes want to use a saline drip and very occasionally transfusion of blood, the risks of this operation are less than those of walking across Piccadilly Circus. At the end of it there should be no more than slight staining of the side towels, and certainly no more loss of blood than about half a pint. Preliminary infiltration of an adrenalin-hyalase mixture is wise, as well as the use of diathermy for quick control of small bleeding vessels. The only important group of blood vessels that need ligation are the lateral circumflex arteries.

Exposure of the joint and removing articular cartilage—The Smith-Petersen incision is best. After separating the gluteal muscles from the dorsum of the ilium and inserting a pack, the front of the capsule is excised. The limb must then be rotated outwards through at least 90 degrees in order that the whole of the acetabulum may be seen quite easily. Every fragment of cartilage is removed from the acetabulum with the aid of a long gouge, preferably about twelve inches in length because in fat patients and those with well developed muscles a shorter gouge can almost be lost in the depths of the wound. The articular cartilage of the femoral head is then removed. A small incision is made over the lateral aspect of the femur, just below the greater trochanter, through which to insert a guide wire traversing the neck of the femur until its point is seen in the upper part of the femoral head. The length of guide wire inside the bone can be determined by measuring the length of wire still outside the bone and subtracting it from the known total length of the wire. A nail of the correct length is chosen—about one inch longer than the penetrated part of the guide wire so that when it is driven in a full inch will engage in the pelvis (Figs. 4 to 11). But first, one of the most important parts of the operation arises.

Position of the fused hip—Successful function will be achieved only if the hip is fused in a position of neutral rotation with no more abduction than is needed to correct true shortening. The total apparent lengths of the limbs should be exactly equal. In earlier years some surgeons advised that the hip joint should be fused in an externally rotated and abducted position—but this of course is nonsense. Many imperfect results that have been reported have arisen from this out-dated view. The limb must be in exactly neutral rotation with the patella pointing to the ceiling. There must be no more abduction than is needed to correct true shortening, which is seldom more than about 10–15 degrees. There must be no deliberate flexion of the limb. As the patient lies on the table there is enough lordosis to be sure that the final position of consolidation will amount to only 30 degrees of fixed flexion which is quite enough for comfortable sitting and is correct for comfortable standing.

Pull-push clamps—In order to do this it is helpful to use the clamps illustrated in Figures 12 and 13. They are sterilised and screwed over the sterile towels at the end of the table, the feet of the patient being fixed to them with sterile bandages. The total apparent limb length is then corrected by pushing on the normal limb and pulling on the affected limb until the malleoli are exactly level. Care must be taken to see that the apparent equality of leg length has really been achieved by sufficient slight tilting of the pelvis and not by distraction of the femoral head from the acetabulum on the side of the hip that has been exposed. The guide wire is then driven into the pelvis and the nail is punched over it. The final stage of the fusion is to impact fragments of cancellous bone cut from the ilium.

Insertion of cancellous iliac bone—Any surgeon who does this type of fusion of the hip joint often enough knows that even after completely denuding the articular surfaces of the acetabulum and femoral head it is quite difficult to find enough space into which cancellous chip grafts of bone can be punched. It is wrong to say that "the mechanical defect of the Watson-Jones method is the lack of congruity between the enlarged acetabulum and the reduced size of the head; even when packed with bone chips the head touches the acetabulum
Figs. 4-7

Technique of Arthrodesis of the Hip Joint
Special towelling is needed so that both lower limbs, covered with sterile stockinette, are exposed from the feet to the pelvis in order that there may be accurate adjustment of length. A Smith-Petersen incision is made. An essential point of the exposure is full external rotation of the limb through at least 90 degrees so that the whole of the acetabulum is seen, as well as the femoral head. This considerable rotation of the limb must of course be done with sufficient caution to prevent fracture of the neck or upper shaft of the femur.
After the cartilage of the acetabulum and femoral head has been denuded a guide wire is driven from below the trochanter until its point emerges in the upper part of the femoral head. The position of the limbs is then adjusted by special clamps fixed to the lower end of the table so that the total apparent lengths of the limbs are equal, true shortening being corrected by slight tilting of the pelvis with abduction of the affected limb. A nail is then driven over the guide wire into the pelvis. Finally a graft cut from the ilium is slotted into the roof of the acetabulum and screwed to the neck of the femur.
This demonstrates the clamps which are sterilised and fixed over the end of the table and bandaged to both feet so that by pull and push the total apparent lengths of the lower limbs is exactly equal, the malleoli being level.

If the nailing is done at a separate second-stage operation it is better to use a Watson-Jones traction table which makes it easy to get the malleoli exactly level, correcting true shortening by sufficient abduction of the hip and facilitating the immediate application of a plaster spica.
over a small area of contact.” It is still worse to say that “the well known analogy of the orange and the cup cannot be better—before operation the head is like an orange inside a cup, whereas after the operation it is like a peeled orange lying on a saucer” (Charnley 1953). This is a complete travesty of the facts of the operation.

After the nail has been driven into the pelvis the femur should be impacted closely into the acetabulum by hammering over an impactor punch in the trochanteric region. Then it is usually wise to cut a whole thickness graft from the dorsum of the ilium, slightly wedged in shape, the narrower end being driven into a slot cut in the bone just above the acetabulum, and the other end fixed to the femoral neck with one screw (Figs. 20 and 21). At the end of the operation the internal fixation provided by the nail and bone graft should be absolutely sound and firm so that there is no rock at all between femur and pelvis when the limb is moved. The nail itself often provides such a degree of sound fixation that an onlaid iliac graft is not essential (Figs. 18 and 19). If, however, after driving the nail and impacting the femoral head into the acetabulum, there is still slight mobility a graft should be used (Figs. 23 and 24).

It is because of the need for complete internal fixation that during the last ten years we have used a one-stage and not a two-stage operation. Before that, because of the fear of surgical shock after arthrodesis, we used a two-stage operation in which all articular cartilage was first denuded and a plaster spica applied—a procedure that takes no more than about twenty minutes operating time and twenty minutes for the plaster—with the insertion of a nail at a second-stage operation two or three weeks later. This, however, gives no opportunity for noting the degree of success of the internal fixation. Now that anaesthesia has become so good, and the risk of surgical shock is so low, a one-stage operation is done. The denuding of articular cartilage, correction of total apparent length of the femur, insertion of a nail, and onlaying of a bone graft, are all done at the same time, the operating time being in the region of sixty minutes.

**AFTER-TREATMENT OF ARTHRODESIS OF THE HIP JOINT**

*Duration of immobilisation in plaster*—The one essential point that matters in after-treatment is that the limb must be immobilised in a double plaster spica, as far as the toes on the affected side and to just above the knee on the opposite side, for not less than four months. Every attempt that has been made to lessen this annoying and irritating period to three months, twelve weeks, ten weeks, or even less, has caused failure of sound fusion in increasing numbers of patients in direct proportion to the time that the duration of immobilisation has been reduced. It takes at least four months for osteoid and callus to consolidate. Sufficiently strong bone cannot be established in less time than that after fixation of a hip joint where there are such stresses and strains. Unless the patient knows from the beginning that four months of immobilisation in plaster will be needed, and possibly a little longer, it is better not to attempt arthrodesis of the hip joint. Nearly always, although the price is heavy, the patient accepts this. After all, what does four months of relative immobility in bed matter in comparison with the twenty, thirty or more years of happiness that will be enjoyed thereafter? As a rule the plaster spica applied at the time of operation is changed for a more closely fitting cast after a few weeks. The patient can then go home or to a convalescent centre. After four months, clinical tests are made and radiographs are taken to confirm the soundness of fusion. If there is doubt, another plaster spica should be applied for one or two months longer. When it is sure that fusion is sound the knee joint is mobilised by simple active exercise and the patient is taught to walk without a limp, and finally is instructed in running, jumping, climbing or any recreation in which he is interested.

*Mobilisation of the temporarily stiff knee joint*—Although after four or more months of immobilisation in plaster the knee joint will be temporarily stiff, a free range of movement will be regained provided only that strenuous physiotherapy, passive force and manipulation

---

*Vol. 38 B, No. 1, February 1956*
This girl, aged fifteen years, sustained a fracture of the femoral neck. It was immobilised by a nail but as so often happens at this age she developed avascular necrosis of the femoral head with sequestration of about half of it. There is gross irregularity in the shape of the bone. It is obvious that degenerative arthritis will develop by the age of thirty-five years. Why not then go straight to the arthrodesis that will be needed rather than attempting a palliative operation just because she is aged no more than fifteen years?

Very occasionally, as in this case of congenital dislocation of the hip, it may be possible to secure such firm fixation of the femoral head in a hollowed area of the pelvis, together with an iliac graft, as to make the use of a nail unnecessary.
After denuding the joint surfaces and using the internal fixation of a nail an iliac graft is usually driven into the pelvis just above the acetabulum and secured to the femoral neck with one screw. These two cases illustrate the technique.
FIG. 22
After exposure of the joint through a Smith-Petersen incision the limb is externally rotated strongly, usually through 90 degrees, so that the acetabulum is easily seen. Note in this case of a young girl the extent of sequestration of two-thirds of the femoral head (see Fig. 15). This dead fragment could be lifted out with a pair of forceps.

FIG. 23
After denuding all articular cartilage the femoral head is replaced in the acetabulum, a guide wire is driven in from below the trochanter and seen to emerge in the upper part of the femoral head. Then, after adjustment of the limb lengths, the wire is driven on into the pelvis. This illustration shows the nail being driven over the guide wire.
are avoided. The quoted observations from the literature as to the dangers of permanent and painful stiffness of the knee arise largely from surgeons who do not know how to treat a stiff knee. Like every other stiff joint, particularly for example the fingers, elbow and shoulder, so too a knee joint that is temporarily stiff will become permanently stiff if it is irritated and worried by repeated stretching, passive force and violence. But if the patient is encouraged, persuaded and cajoled into his own regular exercise for not more than five minutes at a time, but repeated every hour of the day, the joint will regain at least as much movement as there was before the operation.

Protection from oedema and restoration of the normal circulation—At first the limb that has been in plaster for many months should be supported with a crepe bandage or elastic stocking until the tone of muscles is restored, so that the venous return becomes normal and the tendency to oedema is controlled.

![Image](image_url)

**Fig. 24**

Finally a thick iliac graft is punched into a slot in the bone just above the acetabulum and fixed by one screw to the femoral neck.

Summary of the operative treatment and after-treatment—Before analysing the late follow-up results of patients treated by arthrodesis of the hip joint we would emphasise that in this series there was: 1) complete exposure of the joint with denuding of articular cartilage from the acetabulum and femoral head; 2) internal fixation by means of a nail driven from below the trochanter into the pelvis, or an iliac graft, or usually both; 3) immobilisation in a double plaster spica for at least four months; 4) mobilisation of the knee joint by active exercise alone without passive stretching or manipulation.

RESULTS OF ARTHRODESIS OF THE HIP

Every adversity to the patient that arose within five years of operation has been noted, many not really being related to the arthrodesis itself. For example one had cerebral thrombosis with hemiplegia on the opposite side after twelve months, but still says that the operation was worth while because that limb is now the stronger one by which she can protect the more recently paralysed limb. Two others who died at five months and six months after operation have been excluded from the statistical review because the death of one was from acute appendicitis and the other from a self-administered overdose of barbiturates.

VOL. 38 B, NO. 1, FEBRUARY 1956
Complications of the operation—Two patients sustained subtrochanteric fracture of the femur, one after twelve months and one after two years. There seems no doubt that fusion of the hip joint, by reducing mobility at this level, predisposes to this fracture just below the level of the head of the nail. Two had drop-foot, noted at the time that the plaster was removed, which recovered fully within a few months. It seems probable that the paralysis arose from pressure of the plaster on the lateral popliteal nerve where it winds round the neck of the fibula. One other had a pulmonary infarct at the fourth week from which she recovered. In four there was thrombosis of the femoral vein, two with very troublesome and persistent swelling and oedema of the limb needing the permanent use of an elastic stocking. This complication is quite probably related to the insertion of retractors on the medial side of the joint in exposing the depths of the acetabulum; certainly there should be great care and gentleness in the introduction and holding of such retractors.

Mortality—Of the 141 patients in this review three died. One was an elderly lady who had nail fixation alone and died on the fourth day from fat embolism. The other two had unreduced traumatic dislocations of the hip joint, one dying from surgical shock within twenty-four hours and one from a mismatched blood transfusion. Thus of fourteen patients treated by nail fixation alone there was one death; of seven treated by operative reduction of old unreduced traumatic dislocation of the hip there were two deaths; and of 120 patients with osteoarthritis of the hip joint treated by intra-articular arthrodesis there were no deaths. The safety of any operation of this magnitude does of course rest just as much upon the anaesthetist as upon the surgeon. The surgeon must control bleeding, minimise tissue damage, do no more hammering than is essential, and not waste time. But whereas in former years many pints of blood were transfused we now rely upon the skill of anaesthetists; blood transfusion is hardly ever needed.

Wound infection—Of the 141 patients who were operated upon there was wound infection in five (3-5 per cent), this being based upon a stringent and rigid assessment which means that superficial infection or an infected haematoma was so recorded. In none of these five did infection reach the bone; in none was there interference with bone fusion; and in none did the infection give rise to more than temporary anxiety. Penicillin, terramycin, chloromycetin or other antibiotics were used only occasionally as an umbrella control. We did however always use non-touch technique.

Stiffness of the knee joint—The number of patients who regained less than right-angled flexion of the knee joint was twelve (8-5 per cent). Such limitation of knee movement is of course unfortunate after arthrodesis of the hip because it causes difficulty in sitting, and annoyance in putting on stockings or reaching shoe laces. Over 90 per cent regained comfortable and painless movement of the knee joint to the right angle or far beyond. In 40 per cent of patients of all age groups, even up to sixty-five or seventy years and after immobilisation in a full plaster spica for at least four months, there was normal movement so that the heel could touch the buttock. Figures 26 to 30 show a typical sample of the ranges of knee movement that may be expected. For the few patients whose knee joints remain stiff there are many simple devices to aid in dressing such as tapes attached to the top of stockings, elastic laces for shoes, and long-handled shoe-horns.

Ability to sit comfortably—Look at Figure 25. It is often said that arthrodesis of the hip joint should not be done because it causes difficulty in sitting comfortably. Here are eight men and women who were just told to sit down. Four have sound arthrodesis of one hip joint and four have not. Can you tell which is which? We doubt whether you can. Certainly all who have looked at this photograph so far have been wrong at least half the time. A patient whose hip joint has been arthrodesed may need to sit slightly forwards on a chair and tuck his foot under it, some chairs being more difficult by reason of cross bars, but to say that there is any real difficulty in sitting comfortably after arthrodesis of the hip is wholly untrue, provided of course that there is not also stiffness of the knee. To say that "high
chairs and stools are almost universally preferred to low soft chairs for sitting” (Stinchfield and Cavallaro 1950) is again entirely different from our experience. These patients can sit in any sort of chair, high or low, hard or soft, if only there is good movement of the knee.

Walking and recreations—There is no patient in the series now reported who after sound fusion of the hip joint needed to use a walking stick. When asked how far they can walk the usual reply is: “as far as I want.” This is to be interpreted as anything from three miles to twenty miles according to their instincts and wishes. There is really no limit. It has been said that “walking downhill caused an increase in the severity of the limp and a slowing of pace . . . stair-climbing was awkward ” (Stinchfield 1950). This again is exactly contrary to our experience of arthrodesis of the hip. If there is any difficulty at all in walking downhill or uphill, or downstairs or upstairs, the slight stiffness of the hip with free mobility of the knee makes it more difficult to go up than down. But the fact of the matter is that these patients never wonder which is the more difficult, and there is no question at all of increasing the severity of the limp because they have no limp. Figure 31 shows a patient aged fifty-three years who after arthrodesis of the hip joint has gone back to rock climbing in North Wales and the Lake District. Another patient spends at least one month every winter ski-ing in Switzerland. One is a railway track-man who walks ten miles a day over railway sleepers for five days of each week. One is a porter at Chester station who is no less agile than any other. One is a salesman who drives his car fifteen or twenty miles every day. There are three nurses, and it is interesting to note that one, by reason of the arthrodesis of the hip, was rejected from training in a London teaching hospital but thereafter went to the Robert Jones and Agnes Hunt Orthopaedic Hospital and proved to be one of the best nursing sisters they ever had. There is virtually no occupation or recreation that is impossible after sound fusion of the hip joint in a neutral position—neutral rotation with no more abduction than is needed to correct true shortening, and no more flexion than arises when the patient lies flat on the table.
These five patients are a fair sample, representing the degree of knee joint movement that is regained after arthrodesis of the hip joint with immobilisation in plaster for not less than four months. Flexion of the knee joint to the right angle, or even the full range of movement, heel touching buttock, is regained in over 90 per cent of cases.
Pain in the low back after arthrodesis of the hip—Of the 141 patients who were re-examined five to twenty-five years after arthrodesis, ninety declared firmly that they had no pain at all in the low back. Only fifty-one said that sometimes they had pain or discomfort. Even of these, one said that there had never been pain in the back until recent weeks when she had influenza—there are of course many sources of low back pain. Far from it being true that when the hip is fused "excessive strain is thrown on the lumbar spine" or that low back pain is "present in all age groups" we find that 74 per cent of patients had no such pain at all. Perhaps this was because their hip joints were fused in a neutral position with neither excessive abduction nor too much flexion. There is only one patient in the whole of this series who thinks that the pain in the back is worse after the hip joint was arthrodesed. Many said that their low back pain had been relieved or cured by the operation. There can be little doubt that low back pain associated with osteoarthritis of the hip joint arises from unsound ankylosis of the joint in a position of deformity, and from strain of the lumbar intervertebral joints, rather than from increased mobility in consequence of stiffness of the hip. It is time that we renounced once and for all the old view that fusion of the hip causes pain in the low back.

Failure of fusion of the joint after intra-articular arthrodesis—Of the 120 patients with osteoarthritis of the hip joint treated by intra-articular arthrodesis with nail fixation and bone grafting there was failure of fusion in seven. Of these, six had been treated by the former two-stage operation, and one by the one-stage operation. On looking back through the records it seems evident that these failures arose because the patient was released too soon from the full length plaster spica. Even although the hip had been immobilised for several months, undue reliance had been placed on the nail and mobilisation had been encouraged too quickly.

It is true that some of these patients gained considerable relief even from the fibrous ankylosis, but the result in terms of functional activity fell far short of that to be expected by sound bony ankylosis. As soon as it is recognised that fusion of the joint is unsound it is wise to suggest a second operation with further grafting of bone. It is of course hard when a patient has submitted to a big operation and several months of immobilisation in plaster to suggest yet another operation and again another four months in plaster. We can say only that the last patient whose attempted fusion of the hip joint six years ago failed, with pseudarthrosis which in the end caused fracture of the nail, said last week how glad she was to have been persuaded to have another operation. Now that she knows the benefit of a soundly fused hip she thinks that it has all been worth while; and she is sixty-three years of age.

Arthrodesis for congenital subluxation and dislocation of the hip—No hip joint is more easy to arthrodesate than a congenital subluxation, the forward and upward displacement of the femoral head making exposure so easy. But when there is complete congenital dislocation of the hip joint, the femoral head being in contact only with the dorsum of the ilium well above the acetabular level, difficulties arise. First, at this level, there is limited contact of the femoral head with the ilium. The ilium against which the femoral head lies is very shallow; anteverision of the femoral neck and other disparities of shape may make it difficult to secure arthrodesis with good apposition of the femur to the pelvis with at the same time correction of true shortening by sufficient abduction of the limb. It may even be necessary to do a subtrochanteric osteotomy at the time of arthrodesis in order to realign the limb. There were eleven patients in this series with complete congenital dislocation of one hip joint all of whom gained sound fusion.

Arthrodesis of the hip for failed cup arthroplasty—In four patients the hip joint was arthrodesed after failed cup-arthroplasty. There is really no difficulty. All that is needed is to remove the vitallium cup, refreshen the joint surfaces, and proceed exactly as for any other arthrodesis.

Arthrodesis for failed McMurray osteotomy—This is a much more difficult problem because there is need to deal both with an arthritic hip joint in which there is still painful movement, and with an ununited subtrochanteric osteotomy. There were four such cases in this series.

VOL. 38 B, NO. 1, FEBRUARY 1956

Y2_10
Sound fusion was gained in all four, but only with difficulty. It is obvious that the standard operation cannot be performed. The hip joint cannot be dislocated in the ordinary way for full exposure of the acetabulum. All that can be done is to denude the articular cartilage from the roof of the acetabulum and upper part of the head of the femur as far as possible without displacement of the joint. This, together with the impaction of cancellous bone fragments and the insertion of a nail, completes the first part of the operation. There still remains the problem of fusion of the ununited subtrochanteric osteotomy which is best achieved by the grafting of cancellous bone from the ilium rather than by the use of heavy cortical grafts from the tibia (Figs. 34 and 35).

CONCLUSIONS AND SUMMARY

1. This is a simple clinical study of the end-results of arthrodesis of the hip joint in patients followed up and re-examined five to twenty-five years after operation.
2. The study was stimulated by our astonishment at recent reports which suggested that arthrodesis of the hip caused serious operative mortality, a high rate of wound infection, and failure of sound fusion in one of every two cases; and that even when sound fusion was gained there was always pain in the back and usually stiffness of the knee. To say that we were astonished puts it mildly.
Do you know which of these two sitting on the motor scooter has had an arthrodesis of the hip? In fact it is the pillion rider.

This is the patient whose radiographs were shown in Figures 16 and 17. She rides horseback very happily.
Osteoarthritis of the hip treated by a McMurray osteotomy which failed to unite.

The hip joint was fused by refreshing the joint surfaces and inserting a nail, the osteotomy being refreshed with grafts of cancellous bone from the ilium. This was one of three ununited McMurray osteotomies for osteoarthritis of the hip in which sound fusion of both hip joint and osteotomy was gained.
3. This review includes 120 patients aged from ten to seventy years, treated for osteoarthritis of the hip joint by intra-articular arthrodesis with the internal fixation of a nail, usually with an iliac graft, and with immobilisation in plaster for not less than four months.

4. Of these 120 patients there was sound fusion of the joint, proved radiographically, in 94 per cent; a mortality of nil; and recovery of free movement of the knee joint to the right angle or far beyond in 91·5 per cent. Almost half of the patients regained normal movement, the heel touching the buttock. Only in eight patients was there less than right-angled flexion.

5. There was no pain in the back—none whatever—in 64 per cent of the patients. In 36 per cent there was some pain or discomfort. One alone said that the low back pain was worse than before the operation. Many others said that pain in the back had been relieved by the operation.

6. It is emphasised that these results were gained only from sound fixation of the joint in the mid-position with neutral rotation, no more abduction than is needed to correct true shortening, and no more flexion of the joint than that with which the patient lies on the table. The limb was immobilised in plaster for at least four months after operation. The stiff knee was mobilised by the patient's own exercise without passive stretching, force or manipulation.

7. Two other groups of patients are considered. There are fourteen treated by fixation of the joint with nail alone, an operation that was never intended to arthrodes the joint and which has long since been abandoned. The other small group is that of patients with old unreduced traumatic dislocation of the hip, a procedure in which the risks of operation are so great and the number of successful results so small as to dissuade us from attempting operative reduction.

8. After successful arthrodesis of the hip joint patients can return to every household activity and every recreation including skiing, mountaineering, rock climbing, or whatever else they want.

REFERENCES


