

Section of Orthopædics

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President's Address

The Arrest of Early Primary Osteoarthritis of the Hip by Osteotomy

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The Royal Society of Medicine was instituted 'for the cultivation and promotion of physic and surgery and of the branches of science connected with them'. Our Section is of course deeply concerned with the cultivation and promotion of methods of treatment for crippling disorders of the locomotor system. In everyday practice, one of the worst of these is primary osteoarthritis of the hip, that is to say, the common variety which develops insidiously during adult life in a joint previously normal. In my experience it is a greater problem than all the various types of secondary osteoarthritis put together, and the figures quoted by Nicoll & Holden (1961) support this view. Primary osteoarthritis is in fact a great scourge of Anglo-Saxon hip-joints, and in Great Britain, with the average age of the population steadily rising, it is more than ever a cause of pain, disability and frustration.

Unfortunately a cloud of pessimism obscures the whole subject of primary osteoarthritis of the hip, which is still commonly regarded as a process of wear and tear of ageing tissue that cannot help but slowly advance. The synonyms reflect this gloomy opinion. In Great Britain those forbidding words 'morbus coxæ senilis' are handed down from one textbook to another; in the United States of America the term 'degenerative arthritis' likewise suggests a hopeless prognosis.

This despondent attitude has been fostered by a number of surgeons who practise radical surgery for osteoarthritis of the hip. At operation they have noted – quite correctly – that when the head of the femur has been forcibly dislocated and is cut across, considerable areas of cancellous bone are often pale in colour and bloodless. They have assumed on these grounds that in osteoarthritis the blood supply of the head of the femur

is always reduced, and they have supported the notion that *ischæmia* of cancellous bone is an important factor in the disease. With regard to treatment, the forthright opinions of two of our great teachers may be recalled. Here is Sir Walter Mercer writing in 1959: 'The disease is a progressive one and little can be done to stay its course', and Professor George Perkins supporting him in 1961: 'Treatment is palliative.' It is hardly surprising that physicians brought up in this dour climate of opinion are reluctant to seek aid from surgery for their patients and so often advise them to live within the limits of their disability.

The Rise of Osteotomy

The five categories of treatment of disease in general, in descending order of merit, are *prevention, cure and early arrest*, followed by *treatment of late complications* and *palliation*. For primary osteoarthritis of the hip the operations that have been in common use, including high femoral osteotomy for the advanced disorder, fall into the two lowest categories.

That is why Harrison, Schajowicz & Trueta (1953) could introduce their definitive account of the genesis of the disease with these provocative words: '*Effective measures have been devised only for the treatment of the advanced stage of the disease . . . The vogue acquired by these operations proclaims our failure to arrest, and even more to reverse, the progress of the disease before the joint has been completely disorganised.*' Nevertheless, there is a growing body of evidence that osteotomy, when performed before half the range of flexion has been lost and before the joint has started to collapse, seldom fails to relieve pain and halt the progress of the disease (Fig 1), and so earns promotion to the category of *Early Arrest*.

Osteotomy was first practised in late cases with considerable deformity of the limb, but its most striking effect – prolonged relief from severe pain – could not be explained satisfactorily either on mechanical or biological grounds. Radiological improvement on both sides of the joint was sometimes noted and added to the mystery. So

osteotomy came to be labelled empirical or even 'entirely irrational' (Wiles 1958), and like all other effective but empirical treatments it has suffered a grave handicap in the struggle for general recognition. Here one is reminded of pernicious anaemia and its first effective treatment – crude, unattractive and empirical – by the ingestion of quantities of half-cooked liver. Gradually the treatment was refined, the essential principle isolated, its mode of action determined. Now simple, acceptable and rational, treatment is given early by all physicians to such good effect that the word 'pernicious' has lost its old menace.

Osteotomy is following much the same pattern of development in the treatment of this pernicious disease of the hip-joint. The bane of the original technique was the post-operative splintage – incarceration in a double plaster spica for three tedious months. But with internal fixation to control the position of the fragments, the period of convalescence is reduced to about a fortnight in bed with flexion movement of hip and knee encouraged from the start, followed by six or seven weeks on crutches. Thus made more acceptable both to patient and surgeon, osteotomy is being performed at an early stage in a rising proportion of cases, with incomparably better functional results. At the same time, with the aid of research, the puzzling biological effects of dividing the upper end of the femur are submitting to explanation, at least in part, and so osteotomy is gradually shedding the stigma of empiricism and is becoming academically respectable.

The Results of Late Osteotomy with External Splintage

When the late Professor T P McMurray (1935) and Mr Alan Malkin (1936) introduced osteotomy into Great Britain and Australia with their separate reports, the operation was usually performed for advanced cases with a poor range of movement and with deformity obviously requiring correction. On the whole early cases were avoided, and indeed we know that the late Professor Bryan McFarland (1954) at one time regarded a mobile hip-joint and a good long femoral neck as definite contra-indications.

So far as the important range of flexion movement was concerned, the late results were indifferent. In 1950 Osborne & Fahrni reviewed 75 operations at Liverpool, many of them performed by McMurray himself, with the emphasis on oblique division of the bone and full inward displacement of the lower fragment under the pelvis; they found a range of 60 degrees or more of painless flexion in only 19%. In 1956 Campbell & Jackson reviewed 46 operations from Harlow

Wood Orthopaedic Hospital, Mansfield, performed by Malkin's technique of simple transverse division and correction of deformity; 40 degrees of flexion movement were recorded in only 25%. Then in 1960 came Shepherd's careful analysis of 134 operations performed by various surgeons, some of whom, it is true, had used internal fixation. Looking at each end-result 'as an arthroplasty', she found only 5% excellent and 25% good.

There was, however, a thread of gold in Osborne & Fahrni's report. The careful reader could gather that 81% of the operations gave relief of pain; that 23% of these hip-joints, or 19% of the total, had 60 degrees or more of painless flexion movement – and one exceptional case no less than 120 degrees – giving clinical results considered equal to the best arthroplasty; *and that in every such case the arthritis was arrested, often with radiographic improvement.* Incidentally, all these benefits were thought to stem from the altered mechanical situation. The two cases they chose for illustration could not be described as early; in both pre-operative films Shenton's line was broken, indicating that some collapse had already occurred.

In retrospect one could see that here was a type of operation which only had to be employed soon rather than late to yield a high proportion of painless joints with 90 degrees of flexion and no collapse of bone. But this line of reasoning was not followed up, and in 1957, at Barcelona, McFarland still maintained that the ideal hip for osteotomy was stiff and adducted.

The Superior Results of Early Osteotomy with Internal Splintage

In order to establish the merits of early osteotomy, 43 operations selected from a much larger number performed either by myself or by my assistants have been reviewed two to eight years later by Harris & Kirwan (1963). Only cases treated by internal splintage were selected, external splintage having been practically abandoned. In a study of this type internal splintage has two special advantages: secondary stiffness of the hip from prolonged immobilization is eliminated and the progress of the arthritis can be followed from the beginning in radiographs unobscured by plaster of Paris. Two years was selected as the minimal period for review because the function of the joint and the radiographic appearances may continue to improve over that period.

The term 'early' requires some explanation. Two simple criteria, one clinical, the other radiological, had to be fulfilled before the affected hip-joint earned this description. *The clinical criterion* was based on a measurement that I began to record in the notes only eight years ago, namely,

the range of passive flexion under an anaesthetic with all muscle spasm abolished.¹ This may be twice the range recorded in a conscious patient with the painful joint protected by muscle spasm. Here one may recall that Adam & Spence (1958) found the figures recorded in the pre-operative notes so variable that they could not attempt an accurate analysis of the effect of osteotomy on flexion movement. For a case to be included in this series the range of passive flexion under anaesthesia had to be at least 90 degrees, that is, about half the full normal range. A right angle of flexion movement enables a patient to deal with everyday matters such as shoes, stockings and toe-nails, steep steps and stairs. It is the range of movement to be aimed at if the patient is to be independent of outside aid and special gadgets.

The radiological criterion was a negative one – no evidence of collapse of the bone of the joint. This meant that the head of the femur had to be of good spherical shape apart from osteophyte formation, with Shenton's line intact and any tendency to extrusion or protrusion of the joint quite minimal. The radiological criterion excluded many types of osteoarthritis secondary to incongruity of the joint, and in fact previous films often showed almost normal appearances.

In this group of 43 hips the average duration of painful symptoms was nearly five years, the shortest period being eighteen months. These times answer any criticism that the patients were operated on sooner than necessary; many, indeed, had had years of palliative treatment and some were unable to carry on at work. When Pearson & Riddell (1962) reviewed a large series of cases of advanced osteoarthritis admitted to the Robert Jones & Agnes Hunt Orthopaedic Hospital, Oswestry, they found that the average time from the onset of pain to severe disorganization of the joint was eight years. If the two series are in any way comparable, another three years of delay must have spelt disaster to many of these 43 hips.

The average age at the time of operation was 58 years. Most of the patients being in good general health, this meant an expectation of life usually of the order of fifteen to twenty years – a period amply long enough for the diseased joint to reach a terminal state if left alone.

Clinical Results

The beneficial effects of early osteotomy can be measured by the relief of severe pain and the retention of a good range of flexion movement. In 40 out of these 43 cases the joint was comfortable, the pain of the arthritis having disappeared soon after operation. In 3 patients some

pain in the region of the hip had returned after an interval of several years; in one case this was clearly related to a pin and plate due for removal, but in the other 2 the reasons were obscure. As for the range of flexion movement, *two-thirds of the hip-joints retained 90 degrees or more*, and the remainder between 70 and 90 degrees.

The residual fixed deformity in all of these cases was unimportant and no case developed a late contracture. The stability of the joints was of course good before osteotomy, and it stayed so.

Serial Radiographs

When it comes to judging the effect of any conservative operation on the actual arthritic process, no help can be gained from blood tests as in rheumatoid arthritis, and serial biopsies of bone, cartilage and synovial tissue are out of the question. For the present the decision has to rest on the careful examination of serial radiographs of good quality. The early post-operative views, taken as a rule by a portable machine, have to be excluded because of disturbing factors such as a flexed position of the hip, traction on the limb, or a post-operative effusion into the joint. The important films are those taken one month after operation when partial weight-bearing has been resumed, at three and six months, and at one and two years.

It is useful to scan the serial films in an orderly fashion, noting each time the state of affairs in six respects:

- (1) Articular cartilage (joint space)
- (2) Bone sclerosis
- (3) Cystic appearances
- (4) Flat osteophytes
- (5) Extrusion of head of femur (or protrusion)
- (6) Deformity from collapse of bone

When the first three improve and the second three remain stationary, the result may be called a 'triple response.'

Evidence of Arrest and Regression

In these 43 early cases the radiological results were as follows: Moderate collapse 10%, No change 20%, Improvement 70%.

Moderate collapse in these few cases meant the appearance of a definite break in Shenton's line during the first year. Because many of the joints were approaching a terminal state, some instances of collapse were only to be expected. Nevertheless these particular joints were able to retain 70 degrees or more of flexion movement. The 20% of cases with *No change* could be regarded as examples of arrest of the arthritis, but only with some reserve because of the well-known fact that

¹The term *anaflexion* may be used instead of this long phrase

in untreated cases the radiographic appearances often remain stationary for several years. In the 70% of cases showing *Improvement* there was no doubt that arrest had occurred.

A remarkable reaction of repair of disordered bone or articular cartilage or both can be followed in these cases of regression. Nearly all of it occurs during the first year (Fig 1) and the gain is fully maintained over subsequent years (Fig 2). In the disordered bone of the femoral head and acetabulum the attempt at reconstruction is seen only in the cancellous bone transmitting stress; osteophyte formations remain unchanged.

Clearance of bone sclerosis seems to start subchondrally and may sometimes be observed in films of good quality as soon as a month after osteotomy. (Fig 1B). Occasionally the contrast between a juxta-articular layer of decalcifying bone and a deeper layer of still dense bone is so striking that it simulates a low-grade infective process and may cause undue alarm.

The regression of cysts and cystic appearances also seems to start at subchondral level. When a large cyst extending up to the joint surface can be seen in profile, the first change is the appearance of a thin layer of bone of normal density separating the cyst from the joint cavity and pencilling in the fuzzy joint line. The layer thickens, the cyst tends to shrink in size, and its outlines become indistinct. Regression of cysts is often seen in the outer part of the acetabulum (Fig 3). Small cystic appearances usually disappear without trace.

The Rationale of Early Osteotomy

Why is severe pain banished? Why is such a good range of flexion movement retained? Why does osteotomy excite a healing reaction in disordered bone above and below the joint? Why does grossly degenerate weight-bearing articular cartilage undergo repair despite continued 'wear and tear' for years after osteotomy?

For an answer to at least some of these questions one must turn to research, in particular the Oxford stream that began ten years ago with the detailed account by Harrison *et al.* (1953) of the development of primary osteoarthritis in perfectly normal joints up to the stage of terminal collapse. They showed that the constant initial lesion, starting in early adult life, is patchy degeneration of articular cartilage, mainly in *non-weight-bearing* areas; that the local attempt at repair begins with subchondral proliferation of blood-vessels and leads on to the formation of flat osteophytes; that narrowing of the joint space, once thought to be an early change due to 'wear and tear' of articular cartilage, is in fact a late change; and that osteoarthritis as we see it clinically can be regarded as a grossly excessive

attempt at repair – and here is the point – accompanied by a steadily increasing degree of *active hyperæmia*. They were not slow to conclude that the onset of pain was in some way determined by the level of this hitherto unsuspected hyperæmia. This disclosure of an excellent arterial blood supply to the disordered bone really disposed of the old notions of ischæmia ten years ago but, strangely enough, most workers in the field of osteoarthritis have failed to realize its importance. About this time my colleague, Dr Hubert Sissons, had been examining femoral heads partly resected in the course of Judet operations. He had commented on 'the conspicuous absence of necrotic bone lamellæ', and the hyperæmia was of course the obvious explanation.

Later Trueta (1957) was to describe the adult pattern of arteries that anastomose so freely in the cancellous bone of the upper end of the femur. One of his most beautiful preparations showed that easily the largest system is the confluence of the artery that enters at the digital fossa with the ascending branches of the nutrient artery (Fig 4).

With all this information from Oxford, the immediate relief of pain given by any kind of intertrochanteric osteotomy can at once be explained: division of the large medullary vessels causes a sharp reduction in the level of active hyperæmia of the head of the femur. There is plenty of support for such an explanation from other sources. Many widely different types of treatment that give rapid relief of the pain of osteoarthritis can have only one common factor – reduction in the flow of blood to the femoral head. Here are some of them: transplantation of muscle into a deep crater in the neck of the femur (Venable & Stuck 1946); intertrochanteric forage of the medullary cavity (Shaw & Harris 1960); ligation of all the main vessels round the upper end of the femur to produce a 'crisi vascolare' (Scaglietti 1960); the injection of sclerosant fluids into the neck of the femur; and of course that universal palliative, superficial heat causing generalized cutaneous vasodilatation. A subcapital fracture, rare when osteoarthritis is present, may also relieve pain dramatically.

The pain relief that continues for months and years after the osteotomy has united is difficult to explain. It may be due to a combination of changed conditions in the head of the femur such as improved bone structure (which can so often be seen in radiographs) and a sustained reduction of hyperæmia (which can only be surmised). Sad to relate, nothing is really known about the blood supply after early osteotomy except that it remains fully adequate – aseptic necrosis is unknown.

The maintenance of good flexion movement no doubt is largely due to the abolition of protective

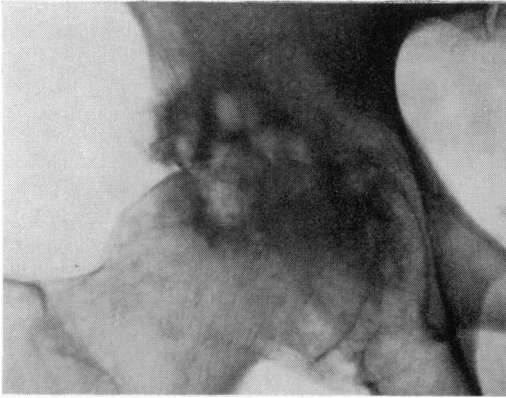


Fig 1A *The pre-operative film. Collapse of bone is imminent*

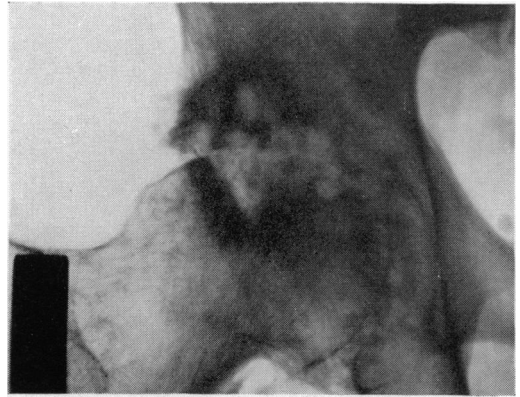


Fig 1B *One month after osteotomy. Clearance of subchondral bone sclerosis has commenced*

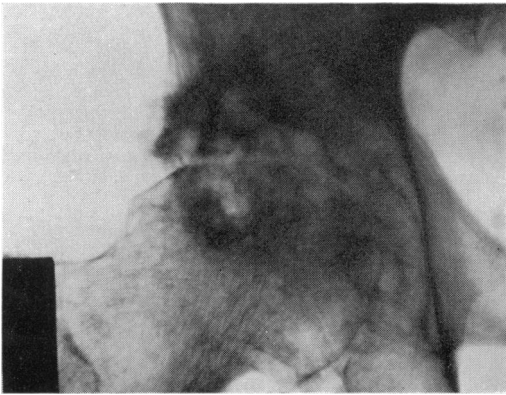


Fig 1C *Three months after osteotomy. There is evidence of a healing reaction in bone and cartilage. (Full weight-bearing was permitted at this stage)*

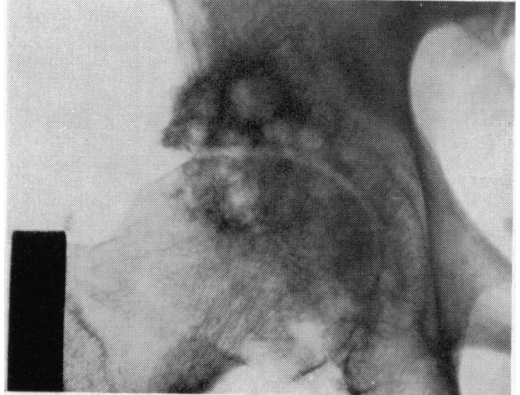


Fig 1D *Five months after osteotomy. The joint space is widening and a layer of subchondral bone of normal density can be seen*

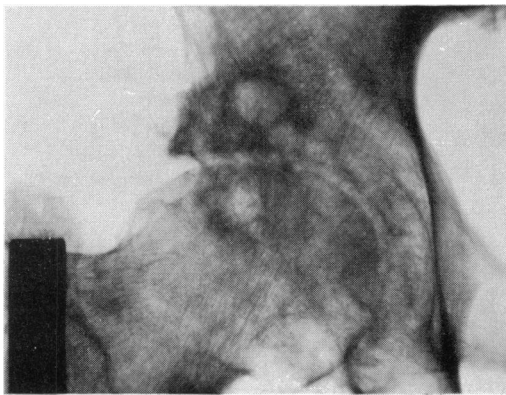


Fig 1E *Seven months after osteotomy. The diffuse bone sclerosis has cleared. The joint is now showing a 'triple response'*

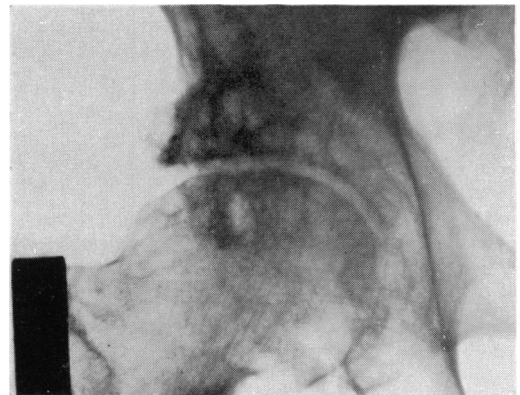


Fig 1F *Twelve months after osteotomy. Radiographic improvement is coming to an end. The joint has been saved from collapse*

Fig 1 *The renaissance after osteotomy of a joint affected by primary osteoarthritis. Note that Shenton's line was intact and remained so*



Fig 2A *The radiograph before operation showing complete absence of the superior joint space and marked subchondral bone sclerosis, but no evidence of collapse. Severe pain for three years*

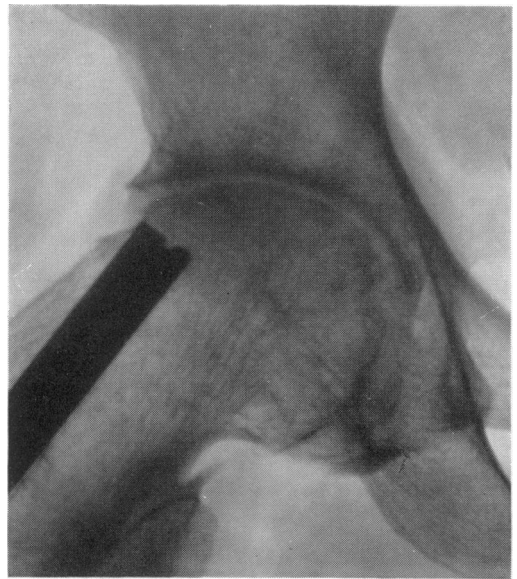


Fig 2B *Eight years after osteotomy with internal fixation. The regression shown here occurred during the first year and is unchanged after seven years of almost normal activity. No collapse of bone has occurred. No pain*

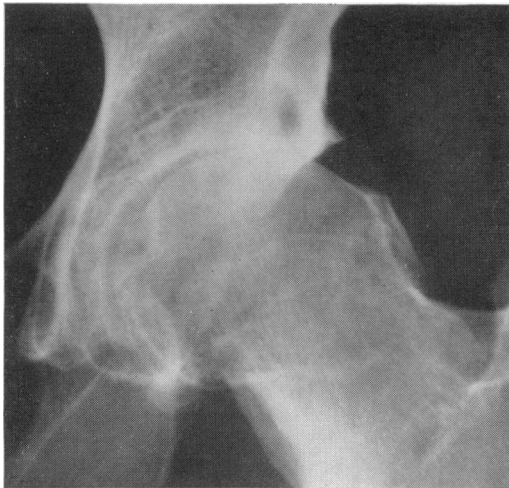


Fig 3A *A radiograph of the hip of a patient complaining of moderate pain for eighteen months. The cystic lesion in the roof of the acetabulum is surrounded by dense bone and the superior joint space is almost absent. The range of flexion under anaesthesia was almost full*



Fig 3B *Three years after osteotomy with internal fixation by a V-spline. The cystic appearance is barely visible, the bone sclerosis has largely resolved and the superior joint space has returned to about half normal width. The hip is comfortable and function is normal*

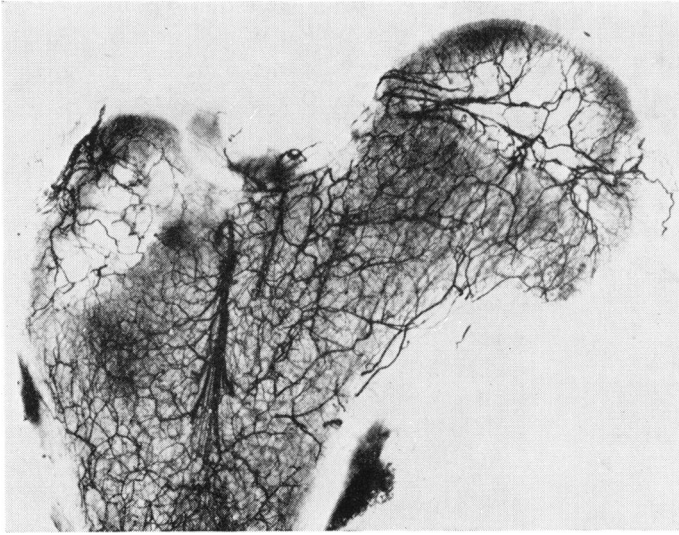


Fig 4 *A Spalteholz preparation of the blood vessels of the head and neck of the femur of a girl aged 17, showing the normal adult vascular pattern. The largest system of vessels is in the intertrochanteric region; it is always divided in the course of osteotomy. (Reproduced from Trueta, 1957, by kind permission)*

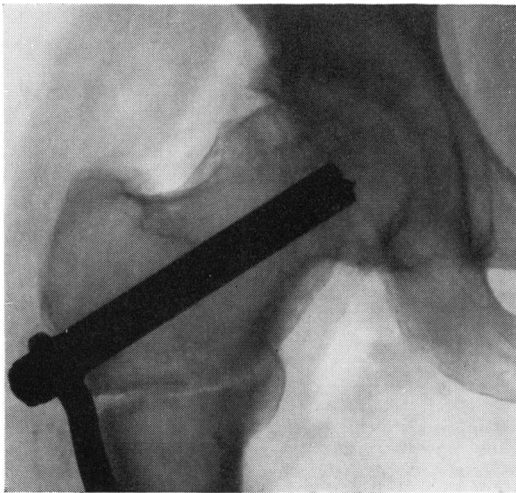


Fig 5A *A radiograph taken after an experimental osteotomy intended to eliminate displacement (see text). The narrow gap left by a Gigli saw persists*

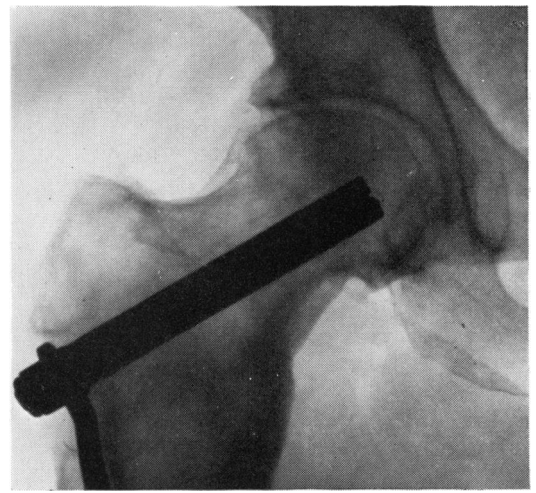


Fig 5B *A radiograph taken nine months later. The marked regression seen in this film has been fully maintained over a further three years*

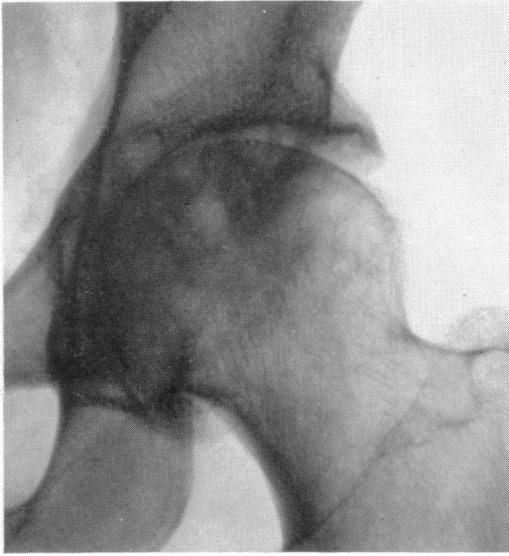


Fig 6A A radiograph showing incipient protrusio acetabuli. The medial joint space is lost and the inner wall of the acetabulum is thin and is tending to bulge inwards



Fig 6B A radiograph three years after osteotomy. The medial joint space has returned, the structure of the spongiosa has improved and no further collapse has occurred. Complete relief of pain

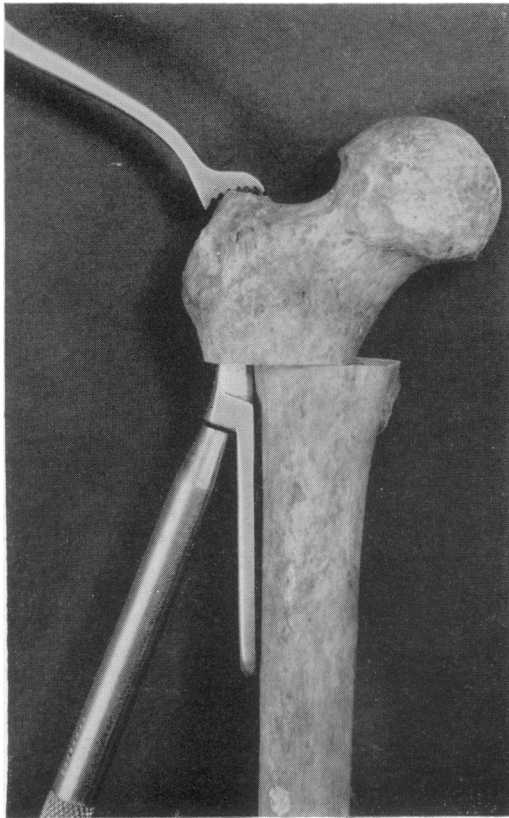


Fig 7 To show the method of insertion of a V-spline while the two fragments are held firmly apposed. The depressor applied to the great trochanter is introduced via a short incision through the fibres of the gluteus medius; this incision also allows the great trochanter to be palpated.

On no account should the end of the spline protrude from the posterior surface of the great trochanter; otherwise the trochanteric bursa becomes inflamed and painful and the spline may have to be removed.

When this technique for cases of early primary osteoarthritis is followed by careful protection from strain for two months the extensive surfaces of cancellous bone rapidly unite. Delayed union is unusual and non-union rare. The upper fragment may settle down into moderate varus, but this position is preferable to valgus because it favours stability of the joint.

(Depressor, handle and spline supplied by Messrs Down Bros.) (Reproduced from Nissen, 1963, by kind permission)

muscle spasm following relief of pain and to a regime of active exercise. It is also reasonable to assume that in these quiescent joints the gross changes in the capsule and synovium seen at open operations have largely resolved, but biopsies taken before and a year or two after osteotomy to show the extent to which this occurs are not available.

The Repair of Disordered Bone

Why does this occur on both sides of the joint at the same time, and so rapidly? Here one must turn to a different line of research – studies with bone-seeking isotopes. At the Campbell Clinic in Memphis, Tennessee, many autoradiographs have been obtained after resection of the head and neck for various lesions being treated by the insertion of a long-stem medullary prosthesis (Calandruccio 1960). In cases of 'degenerative arthritis' an increased uptake in the upper segment of the head of the femur was noted. In Dr Göran Bauer's laboratory at Malmö, Dr Gaston Heripret of Berck Plage (1962, personal communication) has estimated the uptake in the region of the hip in a large number of patients suffering from various grades of primary and secondary osteoarthritis. Without exception the figures have been above normal, rising on average from 1.5 N in early cases to 3 N in advanced cases. These independent findings in resected bone and in living subjects indicate a high level of cellular activity in the disordered bone.

With both the arterial blood supply and the cellular activity augmented, the cancellous bone of the joint, like any other diseased tissue so highly favoured, has the potential both for rapid repair and for long survival. And that of course is precisely what we see in the serial radiographs after early osteotomy (Figs 1 and 2).

The essential stimulus that switches the cellular activity from anarchy over to order would appear to consist of two factors: (1) Complete division of the upper end of the femur, (2) some change of alignment between the two fragments. These are the factors common to every type of osteotomy in daily use, no matter what master is followed—McMurray (1935), Malkin (1936), Pauwels (1959) or Blount (1952).

Anything less than complete division of the bone would seem to be quite inadequate. Destruction of the medulla alone by intertrochanteric forage, though it often relieves pain, fails abysmally to arrest the disease. In some experimental cases I have gone a stage further by dividing all the bone except for the lesser trochanter and then applying a bone plate. Again pain has been relieved, but in no case has a vigorous healing reaction been observed.

The second factor of changed alignment may be regarded as the equivalent of malunion of a fracture. In these early cases it would seem that a minor degree of malunion in *any* direction is enough to make the healing stimulus effective. Medial displacement is certainly not essential; in several cases the original type of McKee pin and plate designed for intertrochanteric fractures has been used for internal fixation, with no medial shift of the lower fragment but with excellent results nevertheless. It is true that some medial displacement is part of the technique of internal fixation with a straight wire, but here the displacement is really a matter of surgical convenience rather than a remnant of McMurray's technique.

In some experimental cases I have tried to perform osteotomy without any displacement at all. In the first case a McKee pin and plate with the usual round screw-holes was applied securely *before* the femur was divided just above the lesser trochanter with the aid of a Gigli saw. This left a narrow transverse gap, because of which union was delayed, and the head and neck, at first in anatomical alignment, almost certainly sank down into a trace of varus. At any rate the healing reaction was remarkably vigorous; by nine months there was a full 'triple response' (Fig 5).¹

Incidentally this case challenges a number of the mechanical explanations for the relief of pain with which the literature of osteotomy is studded – reduced strain from correction of deformity of the limb (Malkin 1936), medial shift of the line of weight transmission (McMurray 1935), relaxation of the contracted joint capsule (Lloyd-Roberts 1953), improved stability (Batchelor 1959), or elimination of tension in the psoas muscle (McFarland 1962, O'Malley 1962).

In subsequent cases the gap was accurately closed with the aid of oval screw-holes in the plate to allow impaction; union was rapid and the tendency for the upper fragment to collapse into slight varus was avoided. But in marked contrast the radiological results up to a year from operation have been poor. As I wrote in 1960, 'it would seem that complete division of the bone together with some element of displacement provides the essential stimulus' for arrest and repair.

How is the stimulus transmitted across the joint to the acetabulum? The factor responsible would seem to be a mechanical one: malalignment sufficient to cause a change of stress in the trabeculae of both the head of the femur and the acetabulum and so to stimulate remodelling of the disordered bone towards a normal pattern. Remodelling occurs in the normal cancellous bone of both components of the joint whenever an

¹Three other cases of marked regression after osteotomy with truly minimal displacement have since been observed

intertrochanteric fracture unites with considerable malunion, though the change in pattern seldom excites comment. In osteoarthritis, however, the process of remodelling can often be followed in serial radiographs when a progressive change for the better in the cystic appearances and bone sclerosis provides the contrast. The 'triple response' following a trace of varus angulation in the case described above (Fig 5) demonstrates the acute sensitivity of the osteocytes to any change of stress in the trabeculae for whose structure they are responsible.

The Repair of Cartilage

The progressive increase in superior joint space so often seen after osteotomy can mean only one thing – repair of damaged articular cartilage despite continued weight-bearing. Osteotomy must in some way reverse the conditions that favour degeneration of this cartilage. We know from examination of resected femoral heads that when the superior joint space is completely absent the only chondrocytes that remain are in small pits scattered over the hard surface of exposed bone (Harrison *et al.* 1953), rather like pinch grafts. Nevertheless, a year after osteotomy the superior joint space may be half normal or more, and it stays that width. In cases of incipient protrusio acetabuli the medial joint space, which is always narrowed and which does not transmit body weight, has also been seen to widen (Fig 6). This indicates that the regeneration of cartilage occurs whether the pressure on it is high or low. Unfortunately there is a dearth of post-mortem material to provide histological detail of this process. It is a most remarkable phenomenon and warrants much more investigation.

Simplification of the Technique of Osteotomy

In these early cases the amount of deformity requiring correction is usually small, and a simple technique, based on the Neufeld type of straight V-spline advocated by Blount and modified by Nicoll, can be used with advantage, provided that the tenuous hold in the upper fragment is kept constantly in mind. The operation is done on an ordinary operating table broken in the middle so as to flex the hip and relax tension in the iliopsoas muscle. Radiographic control is unnecessary.

A spline with a blade two inches long is generally used. Only two special instruments are required. The first is a long knurled handle which can be screwed firmly on to the central boss added by Nicoll; the handle serves to control the spline, to introduce it, and if necessary to extract it. The other is an instrument to hold the great trochanter down while the spline is tapped into and just through the summit, in the way described by Wainwright (1959, personal communication). Either a sharp hook with an extra long handle to pull the great trochanter down or a special depressor to push it down can be used. With

this downward force applied, the transverse osteotomy is tightly closed by abduction of the limb and held so during insertion of the spline (Fig 7). This avoids any tilting of the upper fragment into varus at this stage.

With regard to after-care, protection from strain from adduction and outward rotation of the limb is required over the first ten to fourteen days. A useful routine employs below-knee strapping extension and 6–7 lb weight over a pulley, with the knee well flexed over a pillow; the light traction is interrupted only to permit flexion exercises of the hip and knee under supervision. This period over, the patient is allowed to walk with crutches, taking no more than the weight of the limb on the foot. As a rule full weight-bearing and vigorous exercises in all directions can be started two months after the operation.

The main purpose of this Address has been to proclaim that osteotomy can arrest primary osteoarthritis of the hip, provided it is performed before the joint has become severely disorganized. The time has obviously come for a radical change in our conduct of this disorder. Now that there is well-documented proof of arrest following osteotomy, an entirely new set of clinical judgments to cover individual cases is called for. There is no time for me to elaborate on these, but I would like to stress the need to avoid delay whenever advancing primary osteoarthritis is discovered in healthy men and women under the age of 60 with the prospect of many years of active life ahead of them.

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