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## SURGERY OF THE HIP-JOINT\* PRESENT AND FUTURE DEVELOPMENTS

BY

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In the conditions of the modern world patients with osteoarthritis of the hip are inclined to consider surgical treatment for degrees of discomfort which less than twenty years ago were regarded as inevitable. The orthopaedic surgeon is presented with a problem which has changed completely in two decades. The methods of classical surgery in the past were able to produce gratifying results in osteoarthritis of the hip in patients with pain and fixed deformity, but to-day patients commonly present with hip disorder in such an early form that even the assistance of a stick is not required. A surgeon accepts great responsibility if he recommends surgery before a patient needs a stick, and it takes much soul-searching to decide whether the results obtained in early cases are commensurate with the time and money involved in treatment. The possibility of complications after major surgery in patients affected systemically by degenerative disease needs special consideration.

In a specialty as vast as that of orthopaedics, surgeons yearn for an easy hip operation, or if a good operation is difficult they hope that having mastered its performance through trial and tribulation it should be universally applicable. The orthopaedic surgeon is perturbed by the failure of the Judet arthroplasty, which had been accepted with open arms as respite from the

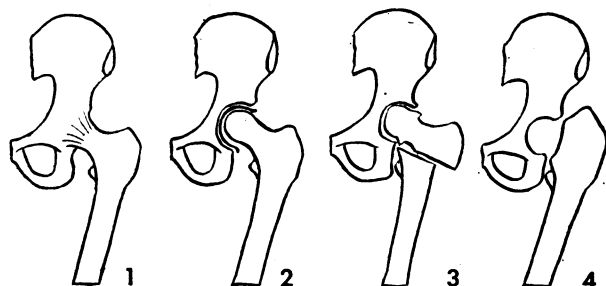


FIG. 1.—The four basic types of hip operation in degenerative arthritis. (1) Arthrodesis: sacrifice of mobility in the interests of stability and freedom from pain. (2) Arthroplasty: the attempt to preserve stability and at the same time retain mobility. (3) Osteotomy. (4) Pseudarthrosis: sacrifice of stability in an endeavour to guarantee mobility.

difficult and capricious operation of cup arthroplasty. The only type of operation that ever could be universal would be an arthroplasty, because this is the reconstruction of a normal joint, whereas operations such as arthrodesis will always be limited to special conditions.

Until an "all-purpose" arthroplasty is discovered the surgeon must select an operative method for each

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patient from one of the four basic procedures of arthroplasty, arthrodesis, osteotomy, and pseudarthrosis (Fig. 1), each of which has numerous technical modifications. How difficult this choice can be, and how it demands clinical experience and acumen, can be realized if we enumerate the factors that influence this choice. We can distinguish seven main groups of disorders of the hip-joint, each of which can be suitable for any of the four methods at some time in their evolution. Excluding tuberculosis, there are: (1) osteoarthritis, (2) rheumatoid arthritis, (3) old congenital subluxation and dislocation, (4) ankylosing spondylitis, (5) late complications of fracture of the neck of the femur, (6) miscellaneous infective conditions of the hip-joint, and (7) the salvage of unsuccessful hip operations.

The permutations and combinations of four operations and seven conditions are increased by four additional considerations: (1) what is suitable in middle-age may be unsuitable in later life; (2) what is suitable for unilateral hip disease may be unsuitable for bilateral; (3) what is suitable for an arthritic hip with a good range of movement may be unsuitable for painful ankylosis in bad position; and (4) what is best for a labourer may be unsuitable for a sedentary worker.

A successful arthroplasty would eliminate the intellectual task of choosing the best operation for the individual problem, but until this happy day arrives it is obvious that the surgery of the hip, far from being a small sub-specialty, is the beginning of a large subject. This type of surgery demands training in mechanical techniques which, though elementary in practical engineering, are as yet unknown in the training of a surgeon. Nowhere in the locomotor system would a liaison with university departments of engineering and colleges of technology be more rewarding than in the biomechanics of the hip-joint. For this reason, one of my aims is to indicate the need for establishing surgical centres to concentrate on the study of the reconstructive surgery of the hip-joint; in these centres men could be trained to master a repertory of different techniques and abandon the tendency, so common in the past, to be a "one-operation man." In such a centre it would be possible to acquire concentrated experience of numerous techniques and to decide the spheres of usefulness of different operations, both old and new.

### Limitations of Arthroplasty

It is important to realize that factors exist which will forever limit the scope of arthroplasty of the hip, no matter how we may study and improve the biomechanical design. It is all too easy to consider the reconstructive surgery of the hip as an exercise in engineering based

on the mechanical distortion of the bones as revealed in the radiograph; but the bony changes are only part of the process which affects the soft parts and which produces the thick capsule and the weakened muscles. In hip disease a fixed adduction deformity indicates that the abductor muscles are defective; therefore to restore normal mechanical conditions in the joint will leave the arthroplasty to be motivated by weak abductor muscles, and adduction deformity and defective function may return. If the head of the femur is replaced by a polished sphere of stainless steel or plastic, surely it is a vain hope to expect an elderly patient to balance securely on the summit of this slippery "universal joint" if strong muscles do not exist to pull the body into balance. It is an axiom in hip-joint surgery that mobility and stability are incompatible, and it would seem reasonable to expect that the most serviceable result ought to be a compromise between these extremes.

That the soft tissues are abnormal in arthritic conditions of the hip can be demonstrated during the operation of "central dislocation" if an attempt is made to increase the exposure by applying manual traction direct to the head of the femur; it is possible to avulse the head of the femur from the side of the pelvis with comparatively little effort in some cases of arthritis, the capsule and even the psoas tendon peeling off the femur to expose bare bone with the greatest ease. But in osteoarthritis superimposed on congenital subluxation of the hip, which is purely a mechanical condition where we can expect the tissues to be healthy, this tearing procedure is quite impossible and every inch of exposure has to be obtained by sharp dissection.

Though these are the factors which limit the quality of an arthroplasty, this must not be taken as an absolute condemnation of arthroplasty, because there exist many patients in whom valuable amelioration has been obtained even though the results fall far short of perfection. But because this pessimistic aspect of the problem has been ignored only too often, patients have been led to believe that the results would be better than in fact they were. It is simply not true to say that the result of an arthroplasty depends on how hard the patient works at rehabilitation: no matter how well a patient co-operates, the quality of the final result depends on the quality of the tissues and on the sound mechanical design of the procedure.

#### Arthrodesis of the Hip

When hip disease is strictly unilateral the functional result of arthrodesis can be so good that it has to be seen to be believed. Whereas it is obvious that in bilateral hip disease some form of arthroplasty is essential, a considerable experience of operations deliberately designed to restrict the range of motion in the hip leads me more and more to believe that the indications for arthroplasty in *unilateral* hip disease are very few. The average result of arthroplasty leaves a patient in the same condition as the early stages of untreated osteoarthritis of the hip: the patient is a mild invalid with an uncertain future, is dependent on a stick, exercise tolerance is limited, and the hip causes a variable and unpredictable amount of mild discomfort. If originally the patient was severely disabled, an amelioration by arthroplasty to this extent will be gratefully appreciated. The result of an arthrodesis, on the other hand, if the opposite hip is normal, is in quite a different category: the patient is in no way an invalid; his condition is that of a person who has completely

recovered from a disease but is left with a residual inconvenience.

The whole-hearted and unreserved gratitude of patients who have been totally relieved of pain as a result of arthrodesis of the hip is so striking that it forces one to realize that pain is the symptom which above all others must be cured in arthritis of the hip, and that the least significant complaint is "stiffness." There is here an interesting point in semantics: patients frequently complain of stiffness when the hip possesses a good range of movement; they often describe the discomfort of the hip as "it feels stiff." Some patients will be horrified by the proposition to stiffen the hip, because they do not appreciate how little they will notice the loss of motion after arthrodesis. With a stiff hip patients imagine that it will be impossible to raise the knee from the surface of the bed when lying supine; they are amazed to learn that it will be possible to lift the knee 6 to 8 in. (15 to 20 cm.) from the surface of the bed, which corresponds with a range of flexion at the hip of 20 to 30 degrees. Many patients with only a few degrees of motion in a painful hip will decline to have the hip stiffened, yet after arthrodesis the hip will actually feel looser; this is because a person with a painless arthrodesis is able to force the hip into postures which previously he was unable to tolerate when the hip was sensitive to passive straining.

In selecting patients for hip surgery it is obviously necessary to consider temperament and personality, and valuable light can be thrown on the magnitude of a patient's suffering by the response to the suggestion of arthrodesis. Anyone with unilateral osteoarthritis of the hip who will utterly reject the idea of arthrodesis without first giving it serious consideration is probably not ill enough for surgery and in all probability will be a difficult patient after arthroplasty.

An argument often advanced in favour of arthroplasty is that with a mobile hip the patient can reach the foot to put on shoes and stockings, cut toenails, etc. This is a most misleading idea, because many patients with early arthritis and a good range of flexion cannot even do these small offices before operation. Most patients after arthroplasty reach their foot by a trick movement from the side, and similar tricks are used after arthrodesis.

The operation of arthrodesis has acquired a bad reputation because by standard methods the post-operative convalescence is long, is often punctuated by serious complications such as thrombosis, and sometimes second operative interventions may be needed before bony fusion is secured. To cause permanent limitation of movement in the knee in the course of an operation undertaken to arthrodesis the hip is a serious handicap to an elderly patient. For these reasons it has been sound clinical judgment for surgeons deliberately to choose a "second-class" arthroplasty rather than to try for a "first-class" arthrodesis by the only methods available in the past. I now believe that new ideas in arthrodesis of the hip will significantly shift the balance in choice between arthrodesis and arthroplasty.

#### Alternatives to Arthroplasty and Arthrodesis

There are conditions of the femoral head in osteoarthritis where cystic changes and bone sclerosis render the possibility of a bony fusion remote and therefore futile to consider. These cystic heads are often seen in the true *malum coxae senilis*. There is therefore a great need for a hip operation combining

the stability of an arthrodesis with a certain amount of mobility, and demanding only a short period of post-operative immobilization. A compromise to suit the problem of the elderly patient with monoarticular osteoarthritis of the hip would be one to function like an arthrodesis when walking, so enabling the patient to throw away his cane and strike the heel briskly on the ground without apprehension, while at the same time possessing a range of 20 to 30 degrees, which would make it possible to sit more perfectly than can an elderly patient with an arthrodesis.

Two operations are available which satisfy these requirements: displacement osteotomy and central dislocation stabilization.

**Displacement Osteotomy**

The idea of using a high osteotomy as elective treatment for osteoarthritis of the hip appears to have occurred almost simultaneously in England to McMurray and to Malkin, and it would appear that both these operators practised this operation with no attempt at a logical explanation of the successful results. Whereas a high osteotomy is a logical procedure when undertaken to correct fixed deformity, the same operation in a mobile hip seems irrational. It was suggested that the medial displacement of the distal fragment was an important element in the operation because this was supposed to impinge against the side wall of the pelvis to form a sort of by-pass to short-circuit the weight-bearing of the body away from the hip-joint.

Osteotomy is still a reliable method of abolishing pain in an osteoarthritic hip. There exists, however, the disadvantage that if plaster fixation is used in elderly patients there may be considerable trouble in recovering movement in the knee, and it may be nearly a year before a patient benefits from what has been a long and arduous experience. The potential for relieving pain by osteotomy has attracted the attention of numerous innovators, and new methods of internal fixation are being developed with the idea of enabling the osteotomy to be performed without plaster fixation. Experience with osteotomy has suggested that the mechanical explanation of relief of pain by medial displacement does not fit the facts, that relief of pain can be obtained by osteotomy without displacement of the femoral head, and that the mechanical problem is subsidiary.

This new attitude to osteoarthritis of the hip is of great interest and may lead to a completely new approach to the treatment of pain as a vascular problem in the femoral head. At the same time I remain decidedly sceptical on the results of an operation judged largely on the subjective element of pain, and, while keeping an open mind on this important aspect of the problem, my approach is primarily concerned with improving the mechanical stability and load-bearing capacity of the joint.

**Central Dislocation Stabilization**

This is an operation which I have been slowly evolving during the last eleven years. It has an advantage over the classical McMurray operation in that the post-operative recovery is quicker and less arduous for the patient. The load-bearing capacity of the hip is increased as indicated diagrammatically in Fig. 2. For maximum stability and comfort it is not desirable that more than 30 degrees of flexion should be obtained. This range of movement is adequate to ensure natural

sitting while at the same time the patient can walk with a hip which is as stable as an arthrodesis.

In this operation the head of the femur is shaped into a cylinder, and the floor of the acetabulum is pierced by a hole large enough to receive the cylindrical head of the femur. This passage of the head of the femur through the floor of the acetabulum (Fig. 3) causes the

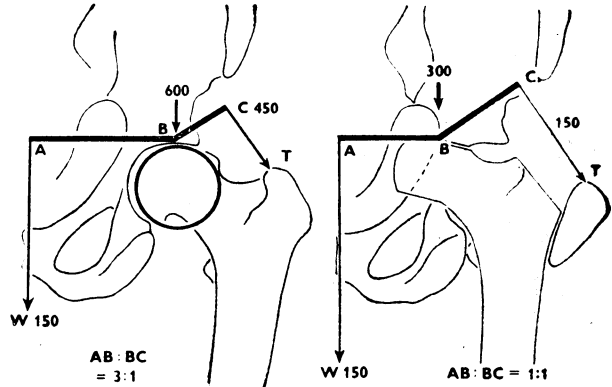


FIG. 2.—The mechanics responsible for the improved stability of the hip after central dislocation. In the normal hip the weight of the body acts as a lever nearly three times longer than do the abductor muscles. After central dislocation, with reattachment of the great trochanter laterally, the mechanical advantage of the gluteal lever is increased and the leverage of body weight is reduced.

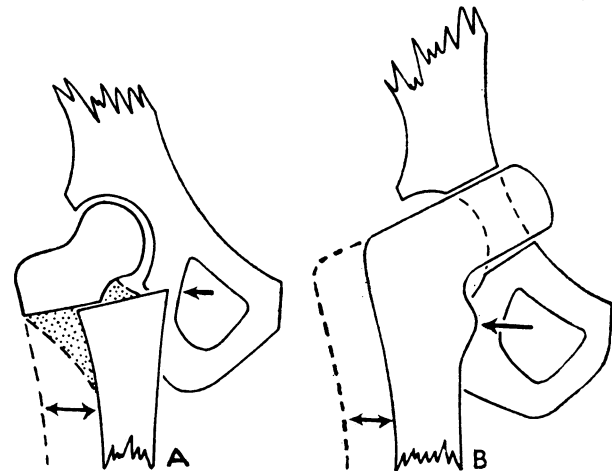


FIG. 3.—The central dislocation procedure (B), showing the basic similarity with the McMurray displacement osteotomy (A). Medial displacement of the line of weight-bearing is common to both procedures and is the mechanical explanation of improved stability.

base of the neck and the region of the trochanters to abut against the lips of the acetabulum and produce a bone-block between the femur and the pelvis. After this operation a minority of patients with osteoarthritis, perhaps 25%, eventually develop a spontaneous bony fusion, but the majority retain a fibrous ankylosis (Fig. 4). The remarkable feature is that this fibrous ankylosis is painless, and one presumes that this must be the result of being supported by the bone-block. The deliberate encouragement of a fibrous ankylosis of the hip is against all accepted canons of surgery, because, in the absence of a bone-block, a fibrous ankylosis of the hip is notorious for developing a progressive flexion-adduction deformity with defective function and return of pain. An experience of eleven years and about 250 cases has convinced me of the value of this procedure, and whatever defects there may be are offset by the short post-operative recovery and the preservation of full knee

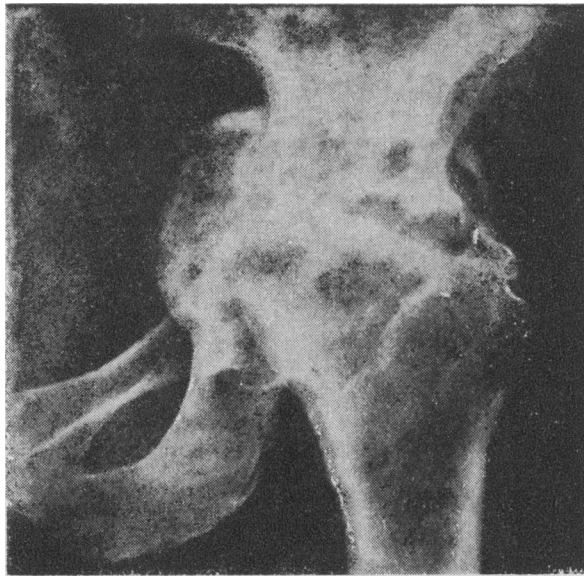


FIG. 4.—Typical fibrous ankylosis accompanying the central dislocation operation.

movement, which makes it available as a method of relieving pain in elderly patients.

The role of the bone-block in restricting rotation and flexion cannot be questioned, but the role of the bone-block in resisting adduction needs special comment. From late results it now seems clear that relief of pain and effective weight-transmission are often obtained

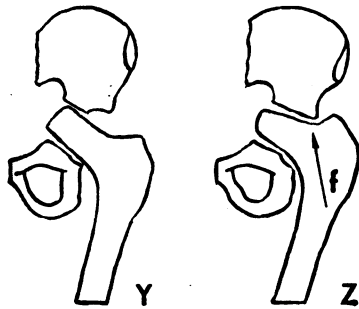


FIG. 5.—The simple central dislocation operation shown in its original form (Y). It can be seen that the neck of the femur is exposed to strong angulatory strains, which can cause it to fracture by fatigue. In the more recent development (Z) an attempt is made to achieve transmission of weight by "neck-bearing" of the acetabulum.

to such a rigid mechanical couple when bearing weight as to cause a fatigue fracture in 5 to 10% of these cases. To avoid the mechanism likely to fracture the neck of the femur I now strive to produce acceptance of weight by the femur as near to the base of the neck as possible, by shaping the femoral head into a varus position.

The operation causes some shortening of the leg; this is not usually more than three-quarters of an inch (2 cm.) of true shortening. It is important to mention this to the patient before the operation, because it is a good test of the patient's desire to be rid of pain if the idea of shortening is accepted with equanimity.

The hip is put into a single-sided hip spica with a little more abduction than is desired in the final result. The foot and ankle are left free to encourage venous return

by the "calf pump." The hip spica is retained for six weeks, during which time the patient can get up and bear weight in the plaster as soon as the general condition permits. The last fortnight in plaster is devoted to early mobilization of the knee by cutting the hip spica down to free the knee-joint. The average period in hospital is eight weeks, and at the time of going home the patient is usually fit to look after herself without assistance.

A technical detail which I think is of value is reattachment of the great trochanter to the outer surface of the shaft of the femur at the conclusion of the operation. This improves the mechanical stability of the hip, reduces any tendency for a late adduction deformity, and assists in holding the femur in full central displacement.

Physiotherapy is not required, as a full range of movement in the knee is never lost and rehabilitation consists of nothing more complicated than encouragement in gentle walking. Most patients are fit for simple domestic duties three months after the operation.

In the minority of patients in whom a fatigue fracture has occurred the result has been salvaged by an osteotomy which, by removing the leverage of the length of the femur, causes union of the fracture and often produces a sound bony fusion of the whole hip.

Disappointing results which I have been shown by others endeavouring to use this technique have invariably been associated with the recovery of too much mobility in the hip, over 40 degrees of flexion range, as a consequence of failing to secure adequate penetration of the femoral head.

#### Arthrodesis by Central Dislocation

While there is no denying the excellent function of a good arthrodesis of the hip, the problem of obtaining osseous union in every case is difficult. If ever any patient is to cope with the inconvenience of a stiff hip it is of paramount importance that full range of movement should be preserved in the knee. The operation of central dislocation can be modified to procure an arthrodesis without significant prolongation of fixation which would prejudice mobility of the knee, and this technique has the safeguard that, even if osseous union were to fail, the result would still be functionally acceptable as fibrous ankylosis ("the second line of defence").

Experience is accumulating to suggest that often it is possible to predict whether a hip is likely to arthrodesise, or become a fibrous ankylosis, from consideration of the age of the patient, the nature of the disease, and the radiological appearance of the bone. In cases where there is considerable cystic degeneration and sclerosis in the femoral head, the probability of a fibrous ankylosis is great no matter what steps are taken in the hope of bony fusion. On the other hand, patients below 45 years of age have a strong tendency to bony fusion because the conditions responsible for arthritis at this age (mild degrees of congenital subluxation, mild infective healed arthritis, and atypical varieties of osteoarthritis) are associated with a full blood-supply in the femoral head without sclerosis and cyst formation.

To adapt the central-dislocation procedure to obtain an arthrodesis the femoral head is made to fit accurately into the hole in the floor of the acetabulum by making it conical, so that it fits the hole like a cork in the neck of a bottle. A spring-loaded compression screw locks the bones together, reinforced by a block of cancellous

bone inserted between the dorsal lip of the acetabulum and the inner surface of the great trochanter (Fig. 6). A single-sided hip spica is applied and knee movements are begun by cutting away the back of the plaster below the knee after the first four weeks. Plaster is retained for a total of eight weeks and unrestricted weight-bearing permitted at eight weeks. The compression screw has spring-loading and the maintenance of pressure can be

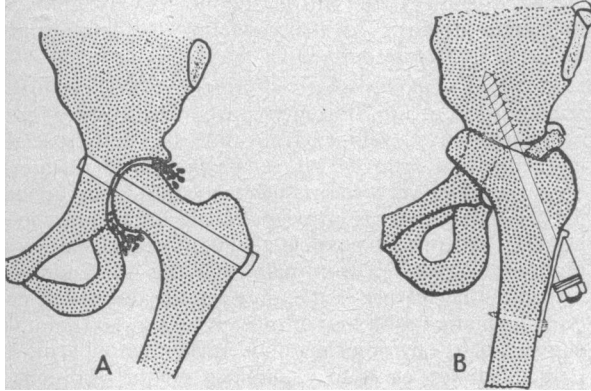


FIG. 6.—Arthrodesis of the hip by the central-dislocation method. In the orthodox procedure of hip arthrodesis (A) the strain on the nail is obviously very severe. In the central-dislocation procedure (B) the interlocking of the bones removes mechanical stress from the compression screw which is used as an adjuvant to fixation.

followed by weekly x-ray films during the first month; if it is thought imperative to obtain osseous union and there is evidence of compression being lost, as manifested by expansion of the compression spring, there are occasions when retightening may be considered.

**Arthrodesis of the Hip in Difficult Problems**

A special centre devoted to the surgery of the hip accumulates problems where an arthrodesis would be the desired solution but where the femoral head is missing or is affected by ischaemic necrosis. This type of patient often is young enough to tolerate three months of plaster fixation. Arthrodesis of these difficult cases has been successfully obtained from experience gained in the central-dislocation operation. The operation is performed in two stages separated by an interval of four to six weeks. If the femoral head is present, this

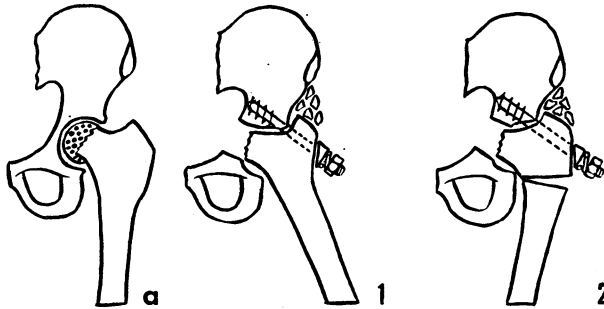


FIG. 7.—Arthrodesis of the hip in difficult problems. Ischaemic necrosis of the femoral head after a high subcapital fracture (a). First-stage arthrodesis (1) with central dislocation of stump of the femoral neck and approximation of the great trochanter to the dorsal lip of the acetabulum in abduction. Spring-loaded compression screw and bone-grafts applied above the great trochanter. Second-stage procedure (2) osteotomy and realignment of the limb in the functional position. The delayed osteotomy precipitates osseous union in the hip by removing the leverage of the length of the femur.

can be dislocated centrally, but otherwise the base of the neck is approximated to the lips of the acetabulum by means of a spring-loaded compression screw. Grafts of iliac chips are applied liberally between the great trochanter and the lateral wall of the pelvis (Fig. 7). At this first stage it may be necessary to place the hip in considerable abduction in order to approximate the living bone of the great trochanter to the living bone of the dorsal lip of the acetabulum and so avoid the difficult problem of grafting across a gap. At the second stage a high intertrochanteric osteotomy is performed to correct the excessive abduction and at the same time to remove the levering action of the long length of the shaft of the femur so that the "de-functioning" osteotomy precipitates osseous fusion in the hip-joint with a high degree of certainty.

**Future Developments in Arthroplasty**

Though we still lack a reliable arthroplasty, research to find one must continue even if its use is confined to the treatment of bilateral osteoarthritis and rheumatoid arthritis. Of all the elaborate operations which have been tried in attempts to reconstruct the conditions of the normal hip, the only one to have survived 25 years in the surgical repertory is the Smith-Petersen cup arthroplasty. Though much less frequently used than formerly, because its results are unpredictable, when they do occur the good results of the Smith-Petersen cup operation can indeed be exceedingly good. But it is difficult to decide if we have learned anything from this operation to help us with further developments because the results of cup arthroplasty do not correlate with mechanical or anatomical factors; as judged mechanically, unsuccessful results may have the cup in perfect position and successful results may have the cup in a poor position. The fact is that the mechanical design of the cup arthroplasty is not sound and Nature sometimes appears to realize this.

However, the cup operation has shown us that a good range of movement combined with reasonable stability cannot be obtained in hip arthroplasty unless an artificial structure is interposed between the head of the femur and the acetabulum. We have also learned the very valuable lesson that in certain conditions, which at the moment cannot be defined, raw bone can be made to generate new articular cartilage when in contact with a polished surface (the "mould" principle of Smith-Petersen). It is possible that the good results of cup arthroplasty depend on this fortuitous circumstance triumphing over the defective mechanical design of the cup arthroplasty.

The Judet operation, in which the femoral head is discarded and replaced by a prosthesis, has failed more completely than the Smith-Petersen cup, but, strangely enough, has probably taught us much more about arthroplasty. We have learned that in prosthetic replacement of the femoral head a close correlation exists between the functional result and a sound mechanical concept of the operation. The failure of the Judet is a late failure, due to mechanical failure of the bond between living bone and the prosthesis; but in the early stages, while the bond remains mechanically sound, the results, judged on the range of movement, the muscular control, and the freedom from pain, have had no equal and far outstrip the early results of the Smith-Petersen procedure, whose concept is totally unsound from a mechanical point of view. We can

therefore take encouragement that ideas based on sound biomechanical concepts may yet prevail.

One aspect of mechanical research into arthroplasty which has not previously received adequate attention concerns the frictional resistance to the motion of an artificial femoral head in the acetabulum. I have collected the evidence to show that the coefficient of friction of normal articular cartilage is phenomenally low (Charnley, 1959), and is in fact lower than anything encountered between solid substances in engineering practice. The coefficients of friction between bone and the substances commonly used in arthroplasty (stainless steel, chrome-cobalt alloy, and "perspex") are many times inferior to the coefficient of friction between normal articular cartilage. The only solid which has a coefficient of friction remotely approaching that of articular cartilage is the plastic polytetrafluorethylene (P.T.F.E.; "fluon"; "teflon"). This has a coefficient of friction better than that between steel and bone, but it still does not approach that of articular cartilage. Preliminary experiments with this substance—which has been under trial for three years—have shown very encouraging results, and, though the method is not yet suitable for general use, it points the way to further work.

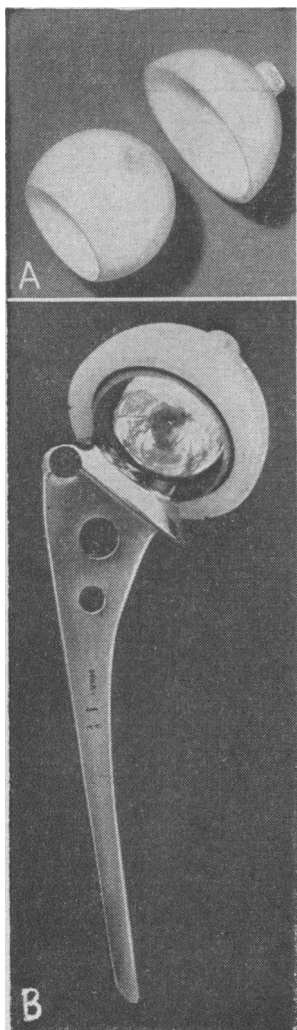


FIG. 8.—Two types of arthroplasty found to be very encouraging in rheumatoid arthritis. (A) Concentric shells of P.T.F.E. used to apply low-friction coverings to the articulation. (B) Stainless-steel prosthesis articulating with a P.T.F.E. socket.

when walking. If a prosthesis could be devised which offered no frictional resistance to rotation in the acetabulum, the bond between prosthesis and femoral neck would be exposed to a force acting purely in a vertical direction and uncomplicated by twisting strains.

My initial experiments with P.T.F.E. used this substance as a "synthetic cartilage." The acetabulum was lined with a thin shell of the material, while the head of the femur was similarly covered with a hollow

sphere (Fig. 8). It was hoped that motion would take place preferentially between the two slippery P.T.F.E. surfaces rather than between one of the P.T.F.E. surfaces and the bone to which it was attached. If the P.T.F.E. implant remained stationary in relation to the subjacent bone, there seemed some hope that mechanical bonding might improve if bone grew into irregularities provided for this purpose.

The difficulty with this design is the possibility of ischaemic necrosis of the remnant of femoral head included inside the cup.

It seems likely that a reliable and valuable amelioration of hip disability can be obtained by forms of arthroplasty developed from this idea, and especially in rheumatoid arthritis, where the prosthesis will never be exposed to very severe mechanical stresses because the patient's activity is invariably restricted by other joint lesions. It appears possible to guarantee the range of motion and freedom from pain after this operation, and a remarkable feature is the almost total absence of new bone formation with loss of motion which is so common in arthroplasty by other methods in rheumatoid arthritis. It is much too early to pronounce on the duration of symptomatic relief. It is probable that in future developments a prosthetic replacement of the femoral head, articulating with a P.T.F.E. socket, will prove more desirable than the double concentric shell of P.T.F.E.

#### Summary

The failure to discover a thoroughly reliable arthroplasty of the hip-joint renders it necessary to employ a number of operative techniques, both old and new, and to study the indications for each according to the clinical problem. When the contralateral hip-joint is normal, operations which abolish pain at the expense of movement probably give the most reliable results. A method of arthrodesis is described which I believe is free from the disadvantages which in the past have limited the use of arthrodesis in osteoarthritis. The possibility of abolishing pain and partially retaining motion by means of osteotomy is a field of investigation which is being intensively explored; it is possible that important biological information regarding the origin of pain in osteoarthritis may evolve from these surgical experiments, but it is too early to make any final opinion.

As regards arthroplasty, the only reliable method of obtaining a large range of motion while preserving reasonable stability demands anatomical reconstruction of the hip-joint, using metallic interposition or a prosthetic replacement. Experiments to improve the mechanical efficiency of arthroplasty, using new plastics having extremely low friction properties, suggest that in the future arthroplasty may have an ideal sphere of application in rheumatoid arthritis. Whereas in the past rheumatoid arthritis has been regarded as unsuited to arthroplasty, it now seems possible that the restricted demands required of an arthroplasty by patients whose activity is limited by disease in other joints may make it possible for them to benefit greatly by techniques which would not stand the wear and tear inflicted on them by less-disabled sufferers.

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