THE PROBLEM OF THE BROKEN JUDET PROSTHESIS

KENNETH H. PRIDIE, BRISTOL, ENGLAND

Arthroplasty of the hip is still in the experimental stage. Workers are still trying to find the ideal procedure for both the relief of pain and the restoration of function. Failure of the hip joint may occur at any age, as a single condition or as part of a generalised joint disease. There can be no one solution to all the multitudes of trouble which we are called upon to treat in the hip.

The first real practical arthroplasty of the hip was the cup operation as devised by Smith-Petersen (1939). The operation was widely used in this country, and I have performed the operation in over a hundred cases. Some did well and some did badly. It was difficult

FIG. 1

FIG. 2

Figure 1—Loosening of prosthesis as shown radiographically. Figure 2—After removal, the prosthesis was found to be broken at its rim.

to foretell before the operation which was to be successful and which a failure. I came to the conclusion that the blood supply of the stump of the femoral neck was the all-important factor in determining the end-result.

When Judet (1950) introduced the acrylic prosthesis it seemed to me that it would provide the answer to many of these problems. It seemed far sounder to get rid of that part of the bone in which the circulation was endangered either by a vascular calamity or by sclerotic changes in the bone itself. I therefore decided to try the Judet arthroplasty in a series of cases.

It became obvious from the beginning that the immediate results were better. The patients were quicker to get on their feet and the range of movement was superior to that after the cup operation. This improvement was apparent, but transient, continuing through the first and sometimes the second year. At about this stage the improvement after the Judet

operation appeared to halt, and complications began to appear. In contrast, the results after the cup operation on the whole continued to improve up to the third year, after which they reached their peak and remained stationary.

FRACTURE OF THE PROSTHESIS

The complications noticed in the Judet operation were a falling off of performance in a previously satisfactory hip, and the gradual reappearance of pain and muscle spasm. The radiograph at this period suggested that the prosthesis was loose (Fig. 1). Then, on watching these cases for several months, occasionally one would come up against a case with a typical fracture of the prosthesis which resembled clinically an intracapsular fracture of the femur. So far I have encountered five broken prostheses in a series of about a hundred cases (Figs. 2 to 4).

The structural breakdown in these cases follows a definite pattern. First the prosthesis becomes loose, then the rim begins to fracture, and finally the stem breaks with the steel insert as well, or the insert remains intact and breaks at a later date. In two cases the fracture was sudden, the insert breaking with the stem. If the disintegration was slow, stages one and two were followed by loss of function, pain and muscle spasm. In stage three there were severe pain and collapse of the leg, and all the signs of an intracapsular fracture of the neck of the femur.

THE PROBLEM AND THE POSSIBLE SOLUTIONS

In discussing the problem of the broken acrylic hip the most important factor to be determined is the magnitude of the problem—its incidence. Next, what is the nature of the substance we are using? Is it reliable or should it be abandoned and should we seek some other solution to the problem of arthroplasty? Is methyl methacrylate the best material for use in the prosthesis?

Disadvantages of methyl methacrylate—The manufacturers claim for it that methyl methacrylate can be given a very high polish. This is true. Even when a prosthesis has been in the body for two years, and when a flat facet has been worn upon it, it still remains smooth. The substance is inert to sodium salts and to organic acids, is a poor conductor of heat and electricity, and is tolerated well by the human tissues. Nevertheless it is not a good substance for a prosthesis for reasons of durability, strength and fatigue.

Surface wear—Firstly, after only one year's wear in an oldish person, there was well marked flattening of the weight-bearing surface. How then can we expect the substance to stand up to a life of activity in an active adult or young person? From its wearing characteristics alone I believe that the operation with the prosthesis has no place in the treatment of the young or middle-aged person with arthritis of the hip, nor should such a prosthesis be used to replace a degenerate head in a patient suffering from Perthes' disease, slipped femoral epiphysis, or fracture of the neck of the femur in a young person.

Breaking strength—Another unfortunate characteristic of methyl methacrylate is the variability of its strength when tested in a breaking machine. Twelve rods, five inches long and nine-sixteenths of an inch in diameter, were deliberately smashed in a machine to record the cross-breaking strain. The rods were individually supported on two V-blocks two and a quarter inches apart, and weight was gradually applied until fracture occurred. Before the test each rod was boiled for thirty minutes and cooled, some quickly and some gradually—it did not make much difference. The least breaking strain was 370 pounds and the greatest 1,230 pounds.

FIG. 3

Prosthesis removed after one and a half year's use in an old person. Note the marked surface wear.

There is an enormous difference, therefore, between the least and the greatest strength. Those with the inserts seemed to be the strongest. The greatest breaking strain when an insert was present was 1,230 pounds and the least was 440 pounds, a difference of about 300 per cent. Without an insert the greatest cross-breaking strain varied between 690 pounds and 370 pounds, a difference of about 180 per cent (Fig. 5).

From these tests it is obvious that the strength of methyl methacrylate is unreliable—so much so, in my opinion, that the material is unsuitable for the manufacture of a hip prosthesis. *Fatigue*—Let us now discuss the nature of the fracture. In only one of the five broken heads was there a history of a fall. One patient was in bed, one at the kitchen sink, another swimming, and a fourth just walking. The fracture is clearly a fatigue phenomenon. **Possible improvements**—The risk of fracture might be reduced by redesigning the prosthesis. A standard two-inch head with a thick rim would be unlikely to break; and if,

FIG. 4
Various types of fracture of acrylic prostheses.

in the design of the stem, the longitudinal flutes were replaced by ridges, its effective diameter would be increased to eleven-sixteenths of an inch instead of less than half an inch as at present.

A method I have been using to reduce the strain on the prosthesis is to place the acrylic head in a metal cup. This cuts down the strain on the acrylic head by increasing the range of movement and preventing the head from being firmly held by the surrounding fibrous tissue. I have not sufficient cases on which to base a conclusion, but so far the results have been excellent.

DISCUSSION

The studies reported here lead me to the conclusion that the acrylic head prosthesis operation should be abandoned for any patient who intends to lead an active life or to earn his living. The originators of the operation have discovered that it was not universally satisfactory, and they have changed their prosthesis to an oblique-angled femoral head, still made of methyl methacrylate. It is a pity that the original operation was so widely publicised when its defects must already have been known.

Remembering again that arthroplasty of the hip is still experimental, we must not be

disheartened by failures. Eighty per cent of our patients are satisfied and consider that the operation has been well worth while. The operation is, I believe, a good one, but the material of the prosthesis has been found lacking.

Treatment of the fractured prosthesis—Among the large number of cases of Judet arthroplasty already performed in this country it must be expected that fracture of the prosthesis will occur in about 10 per cent, and as time goes on the number might be greater. How then are we to treat these cases? In the early stages, when radiographs show that the stem is eccentric, three months in plaster might allow the prosthesis to gain sufficient fixation with fibrous tissue to afford relief. But if this does not help there is no virtue in waiting until the inevitable fracture occurs. The operation should be revised and a more ambitious

FIG. 5

Results of experiments to determine the breaking strain of rods of methyl methacrylate of uniform size. Black columns—rod with steel insert; stippled columns—rod without insert.

type of prosthesis used, such as that advised by Merle d'Aubigné *et al.* (1951). This apparatus must be very strong, for the leverage on it is powerful. A Küntscher or Watson-Jones nail is not nearly strong enough and will break from fatigue in time. Whatever prosthesis we make it must be extremely strong to withstand long-continued stresses.

An alternative solution in cases of fractured prosthesis lies in the Girdlestone (1945) operation, which has certain merits for this complication. Firstly, it is final and introduces no new foreign substance that may break or come to grief in the body, and no substance which will wear. Another good feature of the Girdlestone operation in such a case is that its usual weakness—that is, instability of the hip—is unlikely to be evident, for there will already be a mass of firm fibrous tissue in consequence of the first operation. On the whole, I think that the Girdlestone operation—that is, removal of the head and neck of the femur—is the most satisfactory answer to the problem of the broken or failed acrylic prosthesis.

REFERENCES

- GIRDLESTONE, G. R. (1945): Discussion on Treatment of Unilateral Osteoarthritis of the Hip-Joint. Proceedings of the Royal Society of Medicine (Section of Orthopaedics), **38**, 363.
 JUDET, J., and JUDET, R. (1950): The Use of an Artificial Femoral Head for Arthroplasty of the Hip Joint. Journal of Bone and Joint Surgery, **32-B**, 166.
 MERLE D'AUBIGNÉ, R., CAUCHOIX, J., RAMADIER, J., and POSTEL, M. (1951): Technique, indications et résultats de l'arthroplastie de la hanche avec interposition inerte. Presse Médicale, **59**, 77.
 SMITH-PETERSEN, M. N. (1939): Arthroplasty of the Hip: A New Method. Journal of Bone and Joint Surgery, **21**, 269.