THE TROCHANTERIC RECONSTRUCTION OPERATION FOR UNUNITED FRACTURES OF THE UPPER END OF THE FEMUR*

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When a conscientious surgeon hears a description of a radical surgical procedure he asks himself: what have been the long term results obtained from the operation recommended? What are the indications and technical difficulties of such a procedure, and what precautions have been pointed out by the author in the technique and after-care? The surgical technique of most orthopaedic operations is not difficult in the hands of a capable surgeon, but the difficulty presented both to the young orthopaedic surgeon, and to the more mature, is to choose the procedure most suitable for the particular orthopaedic problem.

The trochanteric reconstruction operation was first performed in April 1931 on a fifty-five-year-old woman who had been treated by the Whitman abduction method and non-union had resulted. This patient presented the typical features of shortening, pain and instability. In the following few years we performed the operation on five other patients with non-union of the neck of the femur; some having aseptic necrosis of the head, but none with gross cartilaginous destruction in the acetabulum. In 1935 we published six cases in the *Journal of Bone and Joint Surgery*.

TECHNIQUE OF OPERATION

The technique has remained practically unchanged since my original paper of 1935. A curved incision is made, beginning one inch behind the antero-superior spine, passing downwards and crossing the femur about five inches below the tip of the greater trochanter (Fig. 1). The fascia is divided and all the muscles attached to the greater trochanter are carefully divided near their insertions. Care is taken not to remove any part of the underlying bone, and to leave the upper end of the femur covered by a thin layer of muscle and fibrous tissue (Fig. 2). The superior gluteal nerve is well out of the operator's way and is not in danger of being injured. The capsule is opened longitudinally and afterwards divided transversely, close to the greater trochanter—preserving as much of the capsule as is possible. The limb is adducted and rotated outwards; the upper end of the femur is freed by cutting the piriformis, gemelli, quadratus femoris and obturator muscles close to their insertions. The loose head is removed and the cervico-trochanteric region inspected. If spicules of the fragment of the neck remain they are chiselled off flush with the inner surface of the shaft and this raw area is covered over with adjacent tissues (Fig. 3). The most favourable type of case is one in which the neck has been completely absorbed, its site being occupied by dense avascular fibrous tissue.

When the greater trochanter has been freed of all its muscle attachments it can be easily pulled down and placed deeply within the acetabulum. In all the patients operated upon the

FIG. 1
The skin incision.

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greater trochanter has been found to be easily reducible and of a size that permitted it to be sunk deeply inside the acetabulum. The thickened capsule and abductor muscles are pulled down while the limb is held in about 20 degrees of abduction. The fibres of the vastus lateralis are identified and separated subperiosteally to expose the shaft of the femur. A bony trough

FIG. 2

FIG. 3

Figure 2—Dotted line of incision for dividing muscles attached to upper end of greater trochanter down to level of lesser trochanter. Capsule incised and sectioned circumferentially close to base of neck. Loose head removed. Figure 3—After removal of head, limb rotated laterally and any nubbin of neck chiselled off flush with medial femoral cortex.

FIG. 4

FIG. 5

Figure 4—Abductor muscles retracted. The upper end of the greater trochanter and the raw bone at base of neck is covered with a layer of soft tissue. A bone slot is prepared laterally ready to receive the downward transplanted abductor group of muscles. Figure 5—After placing the greater trochanter deeply into the acetabulum with the limb in abduction, the abductor muscles are firmly attached to femoral shaft. The vastus lateralis fibres are then reefed over, assuring secure fixation to their new insertion.

is made on the lateral aspect as far down as the abductor muscles, detached from the greater trochanter, will reach when the limb is in about 20 degrees of abduction (Fig. 4). Before the bony trough in the shaft of the femur is made care is taken to have the patella pointing upwards. Two small drill holes are made in the shaft of the femur in an antero-posterior

plane; the muscles are drawn down snugly to this position and held in place by a kangaroo tendon suture (Fig. 5). The vastus lateralis is then carefully reefed over the new insertions of the gluteus medius and gluteus minimus muscles; the wound is closed in layers. A long plaster spica is applied from the metatarsal heads to the axilla with the limb in about 20 degrees of abduction and in full extension (Fig. 6).

POST-OPERATIVE MANAGEMENT

After four weeks the plaster is bivalved; active and passive movements in bed are begun; these movements are helped by an overhead swinging apparatus (Fig. 7).

The leg is held in a posterior splint with a pillow placed between the thighs to prevent adduction for the first few weeks. Active abduction swinging is continued for several weeks

FIG. 6

FIG. 7

Figure 6—Application of a single hip spica which is worn for four weeks after operation. Figure 7—Balanced suspension apparatus applied after removal of plaster. It is important to place sandbag between the limbs to prevent adduction of affected limb.

and is combined with heat and massage to the muscles of the thigh and hip. Eight weeks after operation the patient is usually able to walk with the aid of crutches and is encouraged to walk with a cane as soon as possible (Figs. 8 and 9).

RESULTS

Since the first report in 1935 the operation has been assessed by a number of surgeons. As the result of a questionnaire sent out in 1939 to twenty-one orthopaedic surgeons in the United States we found 121 operations had been performed and that the questionnaires were complete enough to permit a careful analysis of seventy patients. In forty-two of the seventy patients no surgery had been done before the trochanteric reconstruction operation; we found that 60 per cent were excellent and 28 per cent fair; a total of 88 per cent satisfactory results.

Lewis and Ghormley (1954), reporting on fifty-seven patients from the Mayo Clinic, had 73 per cent satisfactory results. Speed (1956) mentioned forty operations done in the Campbell Clinic with 82 per cent satisfactory results.

From 1935 to 1958 almost every patient operated upon by me had had some type of preceding hip surgery; because the closed conservative method of treatment for this type of fracture had largely been superseded by open reduction and pinning or by the use of the stem, or intramedullary, prosthesis.

SELECTION OF PATIENTS AND OPERATIVE TECHNIQUE

For the last few years, in addition to using this operation in selected cases of non-union of the femoral neck, we have also used it in a few patients in whom a stem prosthesis or an intramedullary prosthesis had been used and had failed to give a successful result. We have not felt that degenerative arthritis of the hip joint, in itself, has been a suitable indication. We believe that the cartilaginous destruction of the acetabular roof does not offer the best

FIG. 8

Radiograph of damaged femoral head and non-union after fixation.

opportunity for free and painless movement. Therefore, we do not advocate the operation for the patient with *malum coxae senilis* or for any case that shows a shallow or wandering type of acetabulum as in congenital hip dysplasia, or presents evidence of erosion of the acetabulum by disease or pin protrusion.

All patients presented shortening, pain and instability before operation and the aim of the operation has been to lessen or completely abolish pain, to produce a stable secure hip, and to lengthen a shortened limb. Shortening is particularly evident when the greater trochanter has ridden above its normal position; in these patients traction for a week or ten days before operation has been found to be helpful. Not only must the clinical signs and symptoms be carefully judged in an individual case before operation, but also a great deal of information about the suitability of this procedure can be reached by a careful study of the pre-operative radiographs. Is the head necrotic? Has the head been severely damaged by trauma or previous surgery so that its salvage is not possible? Is the joint space normal, indicating a good covering of cartilage in the acetabulum; and is the acetabulum of normal depth?

In an analysis of the technical difficulties there are several points that one must focus attention upon. Firstly, after carefully exposing the greater trochanter and its attached muscles, we should cut these muscles close to the underlying bone, taking care not to expose bone around the area of the greater trochanter. The lateral rotators of the hip are cut and the capsule is divided close to its insertion around the trochanteric region. This allows the upper end of the femur to be completely freed from its pelvi-trochanteric soft-tissue attachments so that the index finger can be swept freely around the greater trochanter down to the level of the lesser trochanter. If we find, as we frequently do, that a nubbin of the femoral neck remains, it is essential that a sharp osteotome should be used to remove all of the neck flush with the femoral shaft; the raw bony surface is then covered with adjacent soft tissues. This will prevent the greater trochanter from being levered out of its bed after being put deeply in the acetabulum. The greater trochanter, having been put deeply in the acetabulum, with the capsule acting as a curtain over it and the abductor muscles firmly fixed in their new insertion, the limb is then placed in about 20 degrees of abduction in a plaster spica. If the adductors are tight, we tenotomise them, subcutaneously, before applying the spica. Usually, we remove the plaster in four weeks and then place the limb in a balanced suspension apparatus, preventing adduction by putting a sandbag between the legs during the active or convalescent period. Before the wound is closed we must be sure that the transplanted muscles have been properly attached so that the limb is neither in medial nor in lateral rotation, but in the strictly neutral position with the patella pointing upwards. This is easily achieved if the lateral rotators of the hip have been cut as already described. If the limb is in lateral rotation when the spica is applied, the lateral rotators will quickly repair themselves and the limb will be found, unfortunately, to be in a position of fixed lateral rotation. The level of the trochanteric tip is normally from one-half to one-quarter of an inch lower than the level of the upper surface of the femoral head. Therefore, if this inequality is allowed to exist for the first year after operation the trochanter is kept in a more secure position by being in a little abduction. We do not recommend, therefore, any raising of the shoe for many months after operation.

As a precaution against post-operative dislocation one must be careful to have the patient on a firm mattress after the plaster is removed. This is done four weeks after operation, and passive and active movements are begun by the balanced suspension apparatus, encouraging the patient to develop active power in the transplanted abductor muscles as soon as possible. If a therapeutic pool is available it can be very beneficial in developing and improving active abduction before the patient begins to bear weight. Ordinarily we try to get these patients out of bed, with the aid of a walker, seven to eight weeks after operation, graduating to crutches or sticks as soon as they can tolerate it.

We feel that the operation described may offer an opportunity to salvage hips that have been treated unsuccessfully by prosthetic arthroplasty. As Smith-Petersen used to say, "a prosthesis sacrifices the stock so radically that it may be necessary to fuse some of these cases, although the use of this trochanteric reconstruction operation may salvage some of these hips

FIG. 9
Radiograph eight years after the trochanteric reconstruction operation. Functional result excellent.

from arthrodesis.” Although arthrodesis must retain a definite place the complete loss of movement is seldom a desirable feature. Also, the long time required for fusion of the hip in many of these elderly patients makes its use debatable.

SUMMARY AND CONCLUSION

I have attempted to call attention briefly to an operation that has proved to be of use in many patients with non-union of the neck of the femur and have tried to point out not only the indications but also the contra-indications, and to stress some of the precautions in the technique and after-care of the operation. This trochanteric reconstruction operation may help to solve some of the problems related to the ununited hip fracture.

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