THE USE OF THE ACRYLIC HEAD PROSTHESIS IN HIGH FRACTURES OF THE FEMORAL NECK

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This paper reviews the management and progress of sixty-five cases of high fracture of the femoral neck treated by excision of the head and replacement by an acrylic head prosthesis. The behaviour of the reconstructed hip joints has been studied during the second, third, and, in a few cases, the fourth years after operation, and found to follow a definite general pattern, varying slightly with the anatomy of the fracture.

SELECTION OF CASES

All the patients operated on were over sixty, and three-quarters of them were over sixty-five, the oldest being ninety-three. Many were poor subjects for operation, with cardiovascular disease, mild urinary sepsis and chronic bronchitis; but if their condition was not rapidly deteriorating this risk was accepted.

Patients with fractures mainly lateral to the mid-point of the neck have been treated by Smith-Petersen nailing, provided that they were reducible; so this series contains only medial fractures and irreducible lateral fractures. Twelve of the series were operated on from one to six months after the fracture, either because of late diagnosis or of failure of a nailing operation. In all other cases the operation was carried out within ten days of the injury. The term "irreducible" is used for fractures in which, after manipulation, uncontrollable rotation of the head is found to have occurred, preventing accurate coaptation of the fractured surfaces.

TECHNIQUE OF OPERATION AND POST-OPERATIVE MANAGEMENT

Originally the lateral Brackett T-shaped incision, detaching either the greater trochanter or the gluteus medius insertion, was used. This was discontinued, however, as being unnecessarily extensive. The Smith-Petersen incision was used in three cases. The usual approach has been through a lateral curved incision, beginning at the anterior superior spine and passing a little behind the greater trochanter, and vertically down the outer side of the thigh. The capsule was exposed anteriorly in the interval between the gluteus medius and tensor fasciae, and incised in a cruciate or T-shaped fashion. It has been found that if the head is removed by this route the gluteus medius must always be partly detached from the trochanter or it will be stretched and damaged by elevators: the damage is not great, but in elderly patients it is probably important.

In ten of the cases reviewed, and in twenty-five other cases in which the operation was too recent to be included in this series, the posterior approach described by Gibson (1950) was used. There is less bleeding and no damage is done to the gluteus medius; the head of the femur lies more superficially in the incision, and is more easily reached. Also the thin posterior capsule of the joint is incised rather than the thick anterior capsule; this has eliminated the tendency to post-operative anterior dislocation that was observed after operations done through the anterior exposure, and which was attributed to the natural lateral rotation of the limb forcing the prosthesis against a fresh scar in the anterior capsule. The stump of the neck has been trimmed to a reasonable smoothness, though in oblique fractures it has sometimes been impossible to secure a flat proximal surface throughout the whole circumference of the neck. It has been noted regularly that the fracture is more comminuted than the radiographs suggest, especially at the inferior margin of the neck.

The drill hole and the stem of the prosthesis have, in every case, perforated the outer
trochanteric cortex, and the aim has been to place the prosthesis in as valgus a position as possible. In some instances, however, the prosthesis has been placed in insufficient valgus.

In all the cases reviewed, except one, the simple head prosthesis has been used rather than the pattern with a neck extension. In six cases liquid acrylic dental cement has been used to fix the prosthesis into the neck and into the channel bored in the greater trochanter—a method suggested by Kiaer (personal communication). No difference in the results has been observed so far in the cases treated by this method.

**TABLE I**

**AVERAGE POST-OPERATIVE PROGRESS IN SIXTY-FIVE CASES**

<table>
<thead>
<tr>
<th>1. Active straight leg raising and abduction in bed</th>
<th>During 3rd-4th week</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Walking with two sticks</td>
<td>During 4th-5th week</td>
</tr>
<tr>
<td>3. Walking with one stick</td>
<td>During 6th-7th week</td>
</tr>
<tr>
<td>4. Walking without sticks</td>
<td>Only ten patients achieved this standard</td>
</tr>
</tbody>
</table>

**TABLE II**

**ANALYSIS OF RESULTS**

<table>
<thead>
<tr>
<th></th>
<th>First year</th>
<th>Second year</th>
<th>Third year</th>
<th>Fourth year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Early*</td>
<td>Late</td>
<td>Early</td>
<td>Late</td>
</tr>
<tr>
<td>Number of patients studied</td>
<td>53</td>
<td>12</td>
<td>53</td>
<td>12</td>
</tr>
<tr>
<td>Spontaneous complaint of pain</td>
<td>2</td>
<td>1</td>
<td>32</td>
<td>3</td>
</tr>
<tr>
<td>Gait:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slight limp with one stick</td>
<td>45</td>
<td>12</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>Marked limp with one stick</td>
<td>8</td>
<td>—</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Two sticks and sleeping downstairs</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>Adduction deformity</td>
<td>1</td>
<td>15</td>
<td>25</td>
<td>—</td>
</tr>
<tr>
<td>Radiographic appearances:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Progressive shortening of femoral neck since operation</td>
<td>6</td>
<td>1</td>
<td>30 (1 case)</td>
<td>1</td>
</tr>
<tr>
<td>New bone formation in region of capsule</td>
<td>8</td>
<td>3</td>
<td>35 (3 cases)</td>
<td>3</td>
</tr>
<tr>
<td>Increasingly varus position of prosthesis</td>
<td>1 (3 cases)</td>
<td>20</td>
<td>1</td>
<td>25 (1 case)</td>
</tr>
</tbody>
</table>

* Early cases = Hips operated upon within a week of injury.
  Late cases = Hips operated upon from one and a half to six months after injury.

**Post-operative care**—Various methods of post-operative treatment have been used, including 1) continuous traction; 2) plaster boot with incorporated transverse bar; 3) bandaging the limbs together; and 4) plaster spica.

**Continuous traction**—Sliding skin or skeletal traction in abduction was used in fifteen cases. Active movements were encouraged from the second post-operative day. Dislocation of the head of the prosthesis occurred in three patients.

**Plaster boot and bar**—A plaster boot and bar to maintain medial rotation was used in eight cases. Early active and passive movements were practised. One dislocation occurred.

**Bandaging**—Bandaging the legs together with a roll of gamgee tissue was tried in ten cases. The method was discontinued because it made nursing difficult and has proved inefficient. Despite the bandage, the sound limb can be abducted, producing adduction and lateral rotation of the affected leg. Three dislocations occurred.
Plaster hip spica—The application of a single well padded hip spica extending to the mid-calf and holding the leg in medial rotation, 20 degrees of abduction and 30 degrees of knee flexion, was used in thirty cases. The spica was retained for two weeks, during which static exercises to all muscle groups were encouraged; it was then bivalved to allow the patient to practise active exercises from the posterior half of the plaster for a further week. This method has been found generally satisfactory, and even the older patients have tolerated the short period of immobilisation well. No dislocation occurred in the thirty cases mentioned (nor in a further twenty not included in this series). Although movement was started relatively later, the immobilisation favoured rapid healing of the soft tissues, and the patients regained their range of hip movement more quickly, and maintained it better, than they did when movements were begun during the first few days. Gentle passive movements are also of value in encouraging active movement, especially during the first two weeks of mobilisation. Weight bearing was allowed when active abduction of the hip was possible, with the unsupported leg actively raised from the bed. This has usually been during the third or fourth week after operation (Table 1).

COMPILATIONS

The immediate post-operative mortality was six (in seventy-two patients = 8:2 per cent). Two patients died from myocardial infarction, one from pulmonary embolism, and three from renal failure, during the first week. The early complications noted were urinary sepsis, which occurred to a greater or lesser degree in twenty cases; and venous thrombosis in the leg, which occurred in three cases and delayed recovery. The incidence of serious post-operative chest complications was surprisingly low (4 per cent); all patients received penicillin as a routine for ten days after operation. In seven cases anterior dislocation of the prosthesis, which was reduced by manipulation, occurred during the first two weeks after operation. It was always found necessary to apply a hip spica after the manipulation to prevent redislocation: the reduction was never stable. Dislocation did not occur when the posterior approach with post-operative plaster fixation was used (thirty cases).

RESULTS

Fresh fractures (Table II)—In general, in fresh fractures treated by immediate operation, the clinical results have been as follows. During the first year the hip has been comfortable for weight bearing, and the range of movement has, by the fourth month, reached at least two-thirds of the normal in all directions (Fig. 1). The patient has usually used one stick outside, discarding it in the house, and walking with a slight limp but with little or no pain.

During the second year some minor complaints have been the rule, such as aching in the hip, or a disinclination to go shopping or to climb stairs in the house. During the third year 85 per cent of the patients stated that the hip was painful to a greater or less degree. Limp became more marked and movement diminished to a variable extent. In two patients the prosthesis fractured spontaneously during the first year at the junction of the head and stem. The prostheses were excised and replaced with a corresponding loss of function. In one patient the prosthesis dislocated anteriorly after her return home, but whether this occurred...
early or late is not known, for she was mildly demented, and the displacement was not discovered until she was admitted urgently to hospital two years after the hip operation.

**Old fractures** (Table II)—In the small group of old fractures (twelve cases) operated upon late as a secondary procedure, the range of movement has been slower to recover (Fig. 1), but hip function, once regained, has been maintained a little better (Figs. 2 and 3).

![Fig. 2](image)

**Fig. 2**
Case 1. Figure 2—Non-union after fracture treated by fixation with bone peg. Arthroplasty was carried out eight months later. Figure 3—Eighteen months after arthroplasty. The neck has not shortened and function is still improving.

**DISCUSSION**

The technique, complications, and results of hip arthroplasty, using the acrylic prosthesis, have been fully described by Judet and Judet (1950, 1952) and by McAusland (1951). Buxton and Waugh (1953) described their experiences with the method applied to 100 cases of mixed etiology. Vaughan-Jackson (1953) and Le Vay (1953) each reported a series of cases of fresh fracture treated by immediate arthroplasty and observed for up to two years.

It seems from this study that acrylic prosthetic arthroplasty has definite limitations in the treatment of fresh fractures of the femoral neck. The hip function after operation has been sustained a little better in cases operated upon late than in those operated upon immediately, but in both groups a decline in the efficiency of the joint has been the rule. By the third year the neck has become absorbed and shortened to a variable extent in 79 per cent of cases, and the hip has become painful (Figs. 4 to 6).

New bone formation has been a common feature, occurring in the capsular attachments to the acetabular margins and the trochanteric region, and sometimes in the gluteal insertion. It was present in 72 per cent of cases by the second year, and in 92 per cent in the third year.

The alignment of the prosthesis has seldom remained constant. By the second year 36 per cent of cases showed an increase in varus position (Fig. 7), which rose to 80 per cent in the third year; the ten cases in their fourth year all showed gradual varus alteration. Two patients developed acute painful episodes in their first year, due to a small fracture of the neck stump, with resultant varus deformity of the prosthesis.

A study of the eight patients with reasonable function persisting into the third year shows that some new bone formation has occurred in the capsule. The shortening of the neck has been minimal, and, in particular, the inferior border of the neck and the upper part of the femoral head have remained intact. The range of movement has been good in the two patients who have been followed the longest.
Case 2—Two and a half years after arthroplasty. The neck has absorbed and the patient is limping with two sticks. At operation the stump seemed satisfactory.

Case 3. Figure 5—Immediate arthroplasty was carried out. The stump of the neck was intact. Figure 6—Two years later. The neck has absorbed and the patient is limping with two sticks.
Case 5. Figure 8—Immediate arthroplasty for fracture. The stump of the neck was intact and long at operation. Figure 9—Two years later. Function still good and no shortening of neck. Walking well with one stick.
of the calcar have remained intact (Figs. 8 and 9). The bone in this region has evidently become denser and better able to stand the strain of weight bearing. Nevertheless the presence of an intact neck stump seems to be no guarantee of long-term success. Several patients with an apparently satisfactory stump at operation nevertheless developed shortening and varus during the second and third year.

Twelve cases were noted at operation to have either a displaced or undisplaced (and unsuspected) V-shaped fracture of the inferior border of the neck extending into the region of the calcar. The results in these cases were among the poorest. The patients developed pain, rapid shortening of the neck, extensive capsular new bone formation, and adduction deformity; in four cases this was observed after only a few weeks of weight bearing. It is clear that the integrity of this region of the neck is an important factor in prognosis. It is not always possible to diagnose this comminution before operation, but, if it is seen, the experience of the series would suggest that a particularly poor result is likely from immediate arthroplasty, especially if early weight bearing is allowed.

In view of the gradual clinical and radiological deterioration that has been observed in the second, third, and fourth years, it seems that in most cases acrylic substitution as a primary operative treatment for this injury cannot be relied upon regularly to give a satisfactory hip, even in elderly patients who are unlikely to make great demands on it.

SUMMARY

1. Sixty-five cases of medial fracture of the femoral neck treated by substitution of the head by an acrylic prosthesis have been studied.
2. In general, the long-term clinical results of prosthetic arthroplasty after fresh fractures have been disappointing. The method has given slightly better results in the treatment of old fractures.
3. In view of the almost perfect results obtained after successful Smith-Petersen nailing in the presence of an adequate blood supply to the femoral head, it seems unjustifiable to abandon this principle for immediate substitution with an acrylic femoral head. Nevertheless it is believed that an arthroplasty of this type is justified in fractures seen late, and in fresh subcapital fractures when the fracture is irreducible. If a prosthesis is to be used, more protection for the stump of the neck against the strain of weight bearing is essential; a simple head prosthesis is inadequate, and a head with either a neck extension or an intramedullary prolongation may give better results.

I am very grateful to Mr D. L. Griffiths for permission to report fourteen of these cases, and to Mr John Charnley for his invaluable help and advice. I should also like to thank Sir Harry Platt for his encouragement, and Mr Stanley Brentnall who has been kind enough to read the manuscript. The x-ray photographs were produced by the Department of Medical Photography, Wythenshawe Hospital.

REFERENCES


King's College Hospital, Orthopaedic Unit (1950): Arthroplasty of the Hip: a New Operation. King's College Hospital Gazette, 29, 44.

