Between 1983 and 1988 we carried out 45 Charnley low-friction arthroplasties with autografts from the femoral head in 41 patients for developmental dysplasia of the hip. 

The preoperative radiographs were assessed for the severity of DDH according to the classifications of Crowe et al, Hartofilakidis et al and Sharp. The postoperative and follow-up radiographs were analysed for coverage of the socket by the graft, for loosening and for the outcome of the fixation of the bone graft. Two patients died (two hips) at four and seven years after THR from causes unrelated to the surgery and were excluded from the final radiological analysis. The mean age of the patients at the time of operation was 46 years 3 months. The autograft of the femoral head covered a mean 26% (16 to 35) of the acetabular component. All the grafts united. Some degree of resorption of the bone graft occurred in 27 patients, and always involved the lateral part of the graft, which was beyond the margin of the socket. After a mean follow-up of 11 years there had been no revisions and 38 patients had no pain or only slight discomfort. One socket migrated and four others were fully demarced.

Our findings indicate that the Charnley LFA with an autograft of the femoral head for DDH remains successful at a follow-up of 15 years.

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In this prospective study we assessed patients with DDH undergoing Charnley low-friction arthroplasty (LFA) with an autograft of the femoral head to support the deficient acetabulum. There were 33 women and eight men with 45 Charnley LFAs; four had bilateral procedures. Their mean age at surgery was 46 years and three months (24.9 to 73.1) and their mean weight 61.5 kg (42 to 76).

All the operations were carried out consecutively by the senior author (BMW) at Wrightington Hospital. The acetabular deficiency was classified according to Crowe, Mani and Ranawat (Table I), and Hartofilakidis, Stamos and Ioannidis because the latter describe the acetabular pathology more precisely, (Table II and Figures 1 and 2). Sharp’s acetabular angle was used as an additional measurement of the acetabular deficiency.

Through a transtrochanteric approach we identified the transverse ligament and the teardrop, and used Charnley gouges to prepare the acetabulum. Placing the socket at the level of the teardrop required bone grafting of the acetabulum to provide complete superolateral bony cover. Part of the head of the femur was used to supplement the superior deficiency of the acetabulum. The size was determined according to the cover required and the graft shaped with a guillotine designed for the purpose. The superior

Patients and Methods

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subchondral bone was preserved, but curetted free of any fibrous tissue or cartilage. The cancellous surface of the graft was placed against the subchondral bone with the cortical bone offering a better surface for compression screws with washers. The patients were mobilised within one week of surgery and were encouraged to use elbow crutches for partial weight-bearing for up to three months.

In 25 patients components with a femoral neck of three-quarter length were used, in 14 Charnley CDH stems, in three roundback 4O and in another three extra-small Charnley femoral stems. The mean femoral offset was 32 mm (26 to 40).

Patients were seen at three months, one year and then every one to two years. At follow-up, the clinical assessment was carried out according to Merle d’Aubigné and Postel. Union of the graft was recorded as recommended by Conn et al, the extent of graft resorption was graded according to Gerber and Harris and the cement-bone interface at the socket was assessed according to Hodgkinson, Shelley and Wroblewski.

Results

No patient was lost to follow-up, but two died from causes unrelated to the THR at four and seven years after surgery. Both had a successful result clinically and radiologically. The mean follow-up of the remaining patients was 11 years (10 to 15).

Thirty patients had had previous surgery: 14 had femoral osteotomy, six open reduction, three pelvic osteotomy, one a soft-tissue operation and six had conservative treatment. According to the criteria of Crowe et al, there were four hips in group I, 17 in group II, 13 in group III and 11 in group IV.

Using the classification of Hartofilakidis et al, one hip was type A, 29 were type B and 15 were type C. In 35 hips Sharp’s angle was between 43° and 59° and in ten it was greater than 60°. No patient had a normal acetabular angle.

All sockets were placed at the level of the teardrop. The anteroposterior diameter of the true acetabulum determined the size of the socket. The diameter of the cup was 40 mm in 31 cases, 43 mm in five and 38 mm in nine. The mean angle of the cup, open laterally, was 40° (30 to 46) and the autograft of the femoral head covered 26% (16 to 35) of the acetabular component. After one year all the autografts showed evidence of union on radiographs. Some resorption of the graft had occurred in 27 cases. According to the classification of Gerber and Harris, resorption was mild in 24 hips, moderate in two and marked in one. These changes always involved the lateral aspect of the graft, which was not supporting the cup. Resorption reached its maximum at 3 years 7 months (1 year 2 months to 4 years 7 months) and did not progress thereafter.

There were no intraoperative complications. One patient had a trochanteric nonunion and subsequent subluxation on two occasions, but no further surgery was necessary. Four patients had early postoperative thromboembolic complications, two non-fatal pulmonary emboli and two deep-vein thromboses.

At the time of the most recent review no revision surgery had been required, and 38 patients had no pain or only slight discomfort (Merle d’Aubigné and Postel grade 5 or 6). One socket had migrated and four others showed continuous, radiolucent lines (2 to 3 mm). The total incidence of aseptic loosening of the acetabulum was 12% assessed according to Hodgkinson et al. The mean time to radiological loosening was 8.2 years (6 to 10.25). The one socket which had migrated showed demarcation on the radiograph at the time of discharge two weeks after surgery and became loose after six years. The operation note stated that a pressuriser had not been used. There were 15 other sockets with demarcation to some extent but, using the assessment of Hodgkinson et al, they were considered to be stable. There was no correlation between the radiological appearances of the acetabulum and the clinical results as recorded previously.

The mean rate of wear of the socket, measured as penetration for the whole series, was 0.08 mm/year (0 to 0.31). We have examined the relationship between the depth of penetration and the incidence of demarcation and loosening of the socket. Using statistical analysis (Logistic regression test), we found that the depth of penetration had a significant effect on the probability of loosening of the socket (p < 0.01).

The inclusion in the model of age at time of surgery, weight, duration, diagnosis and gender did not have a statistically significant effect on the rate of loosening.

Discussion

Restoration of the acetabular anatomy in patients with DDH is the goal of the surgical treatment and makes the operation technically demanding. The correct placement of the socket was emphasised by Pagnano et al. They suggested that superior positioning, even without lateral displacement, leads to increased rates of loosening of both the femoral and acetabular components. A study by MacKenzie et al found no relationship between the position of the cup
and the rate of loosening while others showed that loosening appeared to depend on the amount of bony coverage obtained at the time of surgery. It has also been suggested that the necessary bony coverage in some hips can only be achieved in the false acetabulum without bone grafting.

The principal mechanical function of an autograft of the femoral head is to act as a supporting structure to the socket and to transmit load. If the autograft extends beyond the limit of the acetabular component, some degree of resorption is inevitable, because this part of the graft will not be loaded. Changes in the graft-host interface were progressive up to a mean of 3 years 7 months, suggesting that four
years is probably the minimum time needed to determine the outcome of fixation of the autograft.

The mean femoral offset was 32 mm and the mean angle of the cup open laterally was 40°. This allowed the use of the smallest possible autografts. Femoral components with a smaller offset would create the need to reduce the angle of inclination of the socket and this would inevitably increase the size of the graft necessary to provide full cover. This results in less favourable distribution of load. By bringing the shaft of the femur closer to the pelvis, the resultant force in the hip increases. The offset of the femoral component may be responsible for the reported catastrophic failures.

The predictive value of the radiograph at one year proved to be only marginally significant because of the small sample size (Wilcoxon rank-sum test, p < 0.02).

There were excellent clinical results up to 15 years, and we recommend this technique. There has been no substantial change in the concept of bone grafting over the years. Preoperative assessment, adequate exposure, availability and selection of instruments and components, correct placement of components and attention to detail at every stage are the most important aspects of the procedure. The wear of the socket will, however, remain a long-term problem.

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References


