THE JOURNAL OF BONE & JOINT SURGERY (BR)

A Dega-type osteotomy after closure of the triradiate cartilage in non-walking patients with severe cerebral palsy

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A total of 47 non-walking patients (52 hips) with severe cerebral palsy and with a mean age of 14 years, (9 to 27) underwent a Dega-type pelvic osteotomy after closure of the triradiate cartilage, together with a derotation varus-shortening femoral osteotomy and soft-tissue correction for hip displacement which caused pain and/or difficulties in sitting. The mean follow-up was 48 months (12 to 153). The migration percentage improved from a pre-operative mean of 70% (26% to 100%) to 10% (0% to 100%) post-operatively. In five hips the post-operative migration percentage was greater than 25%, which was associated with continuing pain in two patients. Three patients had persistent hip pain and a migration percentage less than 25%. In five hips a fracture through the acetabulum occurred, and in another there was avascular necrosis of the superior acetabular segment, but these had no adverse effect on functional outcome. We conclude that it is possible to perform a satisfactory pelvic osteotomy of this type in these patients after the triradiate cartilage has been closed.

A number of patients with cerebral palsy (CP) who are unable to walk develop a hip subluxation or dislocation which causes significant disability.[1-4] Patients and/or carers report hip pain, difficulties in sitting and difficulties with access for perineal hygiene. The benefits of hip reconstruction in these circumstances are well recognised and usually entail a pelvic and femoral osteotomy.[3-8]

Although the concept of a peri-acetabular osteotomy is not new,[9] the peri-acetabular osteotomy described by Pemberton[10] and the transiliac osteotomy described by Dega[11] for developmental dysplasia of the hip have become a standard element of hip reconstruction in CP patients. Jozwiak et al[12] and Grudziak and Ward[13] have clarified the technical aspects of the Dega osteotomy. Others have popularised this approach in the management of the dislocated hip in non-walking patients with severe CP.[4-6,8] These osteotomies are performed before closure of the triradiate cartilage and may pass either into the greater sciatic notch or down the posterior column as far as the triradiate cartilage. All rely on the acetabular segment hinging on the open triradiate cartilage. Roposch and Wedge[14] reported 41 hips in patients with neuromuscular hip dysplasia treated by an incomplete peri-acetabular osteotomy. The medial cortex of the ilium was left intact apart from a bicortical cut situated 1 cm proximal to the anterior inferior iliac spine. The unicortical cut extended down the ilium anterior to the sciatic notch. In 32 hips the triradiate cartilage was open, but in the remainder it was closed. It appeared that a peri-acetabular osteotomy in these patients did not necessarily rely on an open triradiate cartilage, although these authors did not elaborate on this point. Others have described alternative approaches to hip reconstruction after closure of the triradiate cartilage; for example, MacDonald et al[7] described the use of the Bernese peri-acetabular osteotomy, in which the ilium, ischium and pubis are divided for acetabular dysplasia secondary to CP in skeletally-mature patients.

When performing hip reconstruction in skeletally-mature patients with severe CP we have observed that the peri-acetabular bone is easily deformable. We therefore considered it possible to use a peri-acetabular osteotomy that would normally rely on the triradiate cartilage being open. In this paper we report our experience of peri-acetabular osteotomy after triradiate closure in non-walking patients with severe CP.

Patients and Methods

A total of 47 non-walking patients (52 hips) with CP involving the whole body and a mean age of 14 years (9 to 27) underwent peri-acetabular osteotomy together with femoral

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doi:10.1302/0301-620X.88B7.17506 $2.00

J Bone Joint Surg [Br] 2006;88-B:933-7.
Received 5 December 2005; Accepted after revision 7 March 2006

Fig. 1

Photographs showing the osteotomy as the black line. A bicortical cut is made at the anterior inferior iliac spine and a unicortical cut for the remainder of the osteotomy.

derotation varus-shortening osteotomy and soft-tissue correction for hip displacement which caused pain and/or difficulties in sitting. The triradiate cartilage had fused in all patients. The mean follow-up was 48 months (12 to 153). The migration percentage[15] was measured pre-operatively and at the latest follow-up. For the purposes of this study a migration percentage of more than 25% was considered abnormal. The patient's parents or carers were asked what the patient's main functional difficulty was at presentation, and again at follow-up.

Operative technique. All patients had a femoral derotation varus-shortening osteotomy with internal fixation to give a neck-shaft angle of about 120° and physiological anteversion. The lateral aspect of the ilium was exposed through a Smith-Petersen[16] approach via a bikini skin incision. A radiolucent aluminium retractor was placed in the greater sciatic notch and a bicortical cut was made through the anterior inferior iliac spine. A unicortical cut was then made through the outer table of the ilium, around the acetabulum and down into the posterior column[17] (Fig. 1) using a swan-neck chisel (Zimmer GmbH, Winterthur, Switzerland) (Fig. 2). The osteotomy was performed under radiological control and care was taken to avoid penetrating the joint. The chisel has a biplanar curve, which is particularly useful when cutting around the contour of the acetabulum. The chisel did not enter the sciatic notch. The distal peri-acetabular segment was then mobilised away from the body of the ilium with the swan-neck chisel, the osteotomy opened using laminar spreaders and positioned to give maximal cover of the femoral head. The resected bone from the femur was then wedged into the osteotomy to hold the position. Internal fixation was not usually necessary, but if there was doubt about the stability of the graft it was transfixed with a Kirschner wire (Fig. 3). The surgery was carried out by both authors using the same equipment and technique. A total of 11 hips were treated in Edinburgh and the remainder in Basel.

Post-operatively a double plaster spica was applied and epidural analgesia maintained for 72 hours. The spica was retained for three to six weeks, depending on the patient's age. They were then re-admitted to hospital for bivalving of the spica and mobilisation into their wheelchair.

Results

Pre-operatively, 37 patients had hip pain, nine had difficulties in sitting and one had both. Post-operatively five patients had continuing pain, but none had difficulties in sitting according to their parents or carers.

The migration percentage improved from a pre-operative mean of 70% (26% to 100%) to 10% (0% to 100%) post-

Fig. 2

The swan-neck chisels.

operatively (Fig. 4). In five hips the post-operative migration percentage was > 25%, which caused continuing pain in two patients. Three patients had persistent hip pain and a migration percentage < 25%. There was no relationship between the severity of the pre-operative migration percentage and that obtained after surgery.

The procedure was technically possible in all cases, but a fracture through the acetabulum occurred in five hips as the acetabular segment was levered inferiorly. Avascular necrosis of the superior acetabular segment occurred in one hip. However, these complications had no adverse effect on the functional outcome. There were no post-operative infections. The pre-operative, post-operative and latest follow-up radiographs in one patient are shown in Figure 3.

Discussion

Peri-acetabular osteotomy has become a standard procedure as part of the reconstruction of a dislocated hip in CP patients. The osteotomy performed in the present study is similar to that of Roposch and Wedge,[14] who described an incomplete peri-acetabular osteotomy which avoided the sciatic notch. In the majority of their patients the triradiate cartilage was open. The results from the present study show that it is possible to perform a peri-acetabular osteotomy using the same principles, but after closure of the triradiate cartilage. However, there were five fractures into the acetabulum which were noted on the post-operative radiographs, although these did not affect the functional outcome.

Fig. 3a

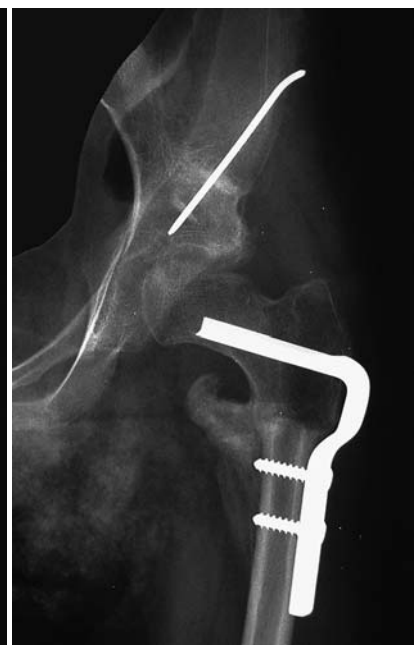

Fig. 3b

Fig. 3c

Radiographs showing a) the pre-operative appearance, b) at three and c) 12 months post-operatively in an 18-year-old woman who had intractable pain in the left hip. A reconstruction was possible despite the femoral head deformity. A Kirschner-wire was used to stabilise the graft in this patient. A severe, pre-operative femoral head deformity was not a bar to a successful result.

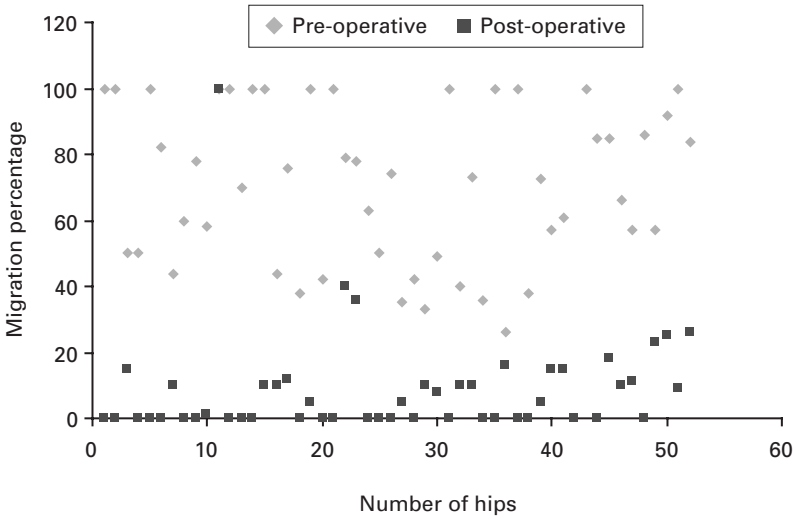

Fig. 4

Graph showing the pre- and post-operative migration percentages.

The evaluation of patients with severe CP is difficult. We relied on the opinion of the patients' parents and carers in determining that the pain originated from the hip and that there were sufficient clinical grounds to justify hip reconstruction. Miller et al[4] noted that the majority of their patients showed an improvement in perineal access, sitting and pain post-operatively. Post-operatively none of our patients had a sitting problem, but five (11%) had continuing pain. The procedure was technically possible, but there was a 10% technical complication rate which did not appear to affect the outcome, possibly because of the low functional demands on the hip in this group of patients. Interestingly, there was no relationship between persistent post-operative pain and the post-operative migration percentage. This is not surprising as patients with severe CP may have an asymptomatic hip dislocation. The femoral shortening at the time of operation may also have contributed by reducing intra-articular pressure. We would emphasise that all patients had a functional problem preoperatively, and that hip displacement on its own was not an indication for hip reconstruction.

Migration percentage is widely used as a measurement in the hips of patients with CP; we used this as a radiological criterion of outcome. The migration percentage may be inaccurate when considering a dislocation other than in a cranial direction,[18] but all hips in the present study were dislocated mainly in a cranial direction.[19] Parrott et al[20] have shown that an experienced investigator would be expected to measure the migration percentage on a single radiograph to within SD 5.8% of the true value and a change in migration percentage between measurements to within SD 8.3% of the true value, which is thought to be sufficient for clinical purposes. The improvement in migration percentage seen in our patients was probably a result of the combination of pelvic and femoral osteotomy. Lengthening of the adductors has been advocated in younger patients.[21] In the age group we treated, soft-tissue lengthening alone would have been unlikely to have a beneficial effect on the migration percentage, as there would have been poor potential for acetabular remodelling. Varus osteotomy would improve the migration percentage by placing more of the femoral head within the acetabulum, provided the acetabulum was not severely dysplastic. The long-term outcome of femoral osteotomy on its own in a significant number of patients in the age group we treated is not known. Brunner and Baumann[22] found that the long-term results after femoral osteotomy alone in younger patients were less satisfactory than those after a combination of pelvic and femoral osteotomies. The addition of a pelvic osteotomy would improve the migration percentage where there was a significant acetabular deformity.

This observational study considered a highly selected group of patients in whom there were major surgical challenges and difficulties in the objective evaluation of pain. We have shown that it is feasible to perform a peri-acetabular osteotomy after triradiate closure in this type of patient using the same surgical principle as when the cartilage is open.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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