COMBINED INTERTROCHANTERIC AND CHIARI PELVIC OSTEOTOMIES FOR HIP DYSPLASIA

M. A. SCHER,  I. JAKIM

From the Hillbrow and Johannesburg Hospitals, Johannesburg

Thirty-two dysplastic hips with secondary osteoarthritis, in 28 patients aged 18 to 42 years, were treated by combined intertrochanteric and Chiari osteotomy. They were followed up for 2.5 to 10 years. Pain was the main presenting symptom in all the patients. The indication for surgery was based on the severity of disease with respect to congruency, secondary degenerative change and degree of dysplasia.

The average pre-operative Harris hip score was 47.7 and the majority had severe dysplasia with degenerative changes. On final review the average score was 88. The radiographic appearances of degenerative arthritis regressed in 72% of hips and dysplasia was improved in all cases. The results of this conservative form of surgery are better in hips with less severe dysplasia and mild secondary degenerative change.

Hip dysplasia in the young adult predisposes to premature secondary osteoarthritis. The poor results of hip arthroplasty in young people, especially if the bone stock is deficient (Charnley and Feagin 1973; Charnley 1979; Door, Takei and Conaty 1983; Collis 1988), makes a biological solution much more attractive.

We have treated these cases by combined intertrochanteric and Chiari osteotomy. This is the first reported series of adult patients with hip dysplasia managed in this way.

PATIENTS AND METHODS

Between 1979 and 1987, 31 adults had a combined intertrochanteric and Chiari pelvic osteotomy for hip dysplasia. Three patients were lost to follow-up and were excluded from this study. Of the remaining 28 patients (32 hips) four were men and 24 were women. Their average age at time of operation was 28 years (range 18 to 42) and the follow-up period averaged 5.5 years (range 2.5 to 10). A total of 16 previous operations had been carried out on ten of the hips. All patients were assessed clinically by the Harris hip score. Radiographs included a standing anteroposterior view of the pelvis, faux profile (Tönnis 1987), antetorsion views and dynamic hip studies (adduction/abduction views in variable degrees of flexion) to demonstrate optimal hip coverage, and degree of congruency.

On radiographs taken pre-operatively, postoperatively, at yearly intervals and at final review we measured CE angle, VCA angle (sagittal cover, Tönnis 1987), Sharp’s angle, percentage acetabular cover and the level of Shenton’s lines. On the first postoperative radiographs the angle, the height and percentage displacement of the Chiari osteotomy were measured. The hips were graded for secondary degenerative change (Table I). A congruency classification (Fig. 1) was integrated into the dysplasia grading (Table II). The congruency classification introduces the diagrammatic representation of dynamic mobility, especially gliding as opposed to hinged movement, and the matching of loaded surfaces. The deformed femoral head in types B to D demonstrates progressive subluxation and decreasing loading surfaces with gliding movement in addition and hinged movement in abduction.

Criteria for osteotomy. The type of osteotomy was tailored to the individual case. In grade I dysplasia (Table II), with a spherical head, we performed either a pelvic osteotomy (Chiari or redirectional) or an intertrochanteric extension osteotomy with a variable degree of varus. Where there was incongruency (flattening of the head), valgus-extension osteotomy was employed.

In severe degrees of dysplasia (grade II onwards) we used a combined pelvic and intertrochanteric valgus extension osteotomy (Fig. 2).

Pre-operative requirements included a range of movement of at least 70° flexion and 20° of adduction, demonstrated if necessary under anaesthesia. Abductor power was at least MRC grade III. Disorganised, stiff
Congruency classification: grade A, normal hip. Grade B, congruous incongruity, femoral head deformed but covered. Grade C, as for grade B but femoral head uncovered. Grade D, incongruous joint with point loading and variable degree of subluxation.

A) Diagrammatic representation of hip dysplasia treated by Chiari osteotomy. Head cover is improved but not congruency, and suprolateral eccentric loading is increased. B) Combined Chiari and intertrochanteric osteotomy improves congruency. Total hip loading is decreased by medialisation and muscle re-balancing, the weight-bearing surface is increased and load per unit surface area is reduced.

joints (grade IV degenerative arthritis) were considered unsuitable for treatment by osteotomy.

**Pre-operative planning.** The valgus component is calculated by adduction of the hip in flexion under fluoroscopy to determine optimal congruency. The degree of adduction measured from the radiograph indicates the amount of valgus required. The extension correction is determined from the degree of flexion required to achieve optimal congruency, the VCA angle, and from the corrected antetorsion view. Correction of a fixed flexion or adduction deformity takes precedence over any other calculations.

Accurate tracings of the anteroposterior radiographs are made, and used to assess length adjustment, lateralisation of the distal femoral fragment (to control knee alignment), and implant position and sizing. Rotational correction is judged intra-operatively.

**Operative technique.** Operations were carried out under controlled hypotensive anaesthesia. The intertrochan-

**Table I.** Radiographic grading of secondary degenerative changes in dysplastic hips, determined by the worst single feature

<table>
<thead>
<tr>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Grade IV</th>
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<tbody>
<tr>
<td>Eccentric loading (increased sclerosis in Pauwels triangle)</td>
<td>Moderate joint space narrowing</td>
<td>Severe loss of joint space</td>
<td>Disorganised joint</td>
</tr>
<tr>
<td>Minimal loss of joint space</td>
<td>Cysts</td>
<td>Capital drop osteophyte</td>
<td></td>
</tr>
<tr>
<td>Superolateral bone re-modelling (osteophyte)</td>
<td>Head shape changes (flat/elliptical)</td>
<td></td>
<td></td>
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<tr>
<td>Mild flattening of head</td>
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</table>

**Table II.** Grades of hip dysplasia, determined by the worst single feature

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Grade IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE angle (degrees)</td>
<td>30</td>
<td>20 to 30</td>
<td>5 to 20</td>
<td>5</td>
<td>Negative</td>
</tr>
<tr>
<td>Sharp angle (degrees)</td>
<td>43</td>
<td>43 to 46</td>
<td>46 to 49</td>
<td>50</td>
<td>&gt; 50</td>
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<tr>
<td>Shenton lines (mm)*</td>
<td>Equal</td>
<td>5</td>
<td>5 to 10</td>
<td>10 to 20</td>
<td>&gt; 20</td>
</tr>
<tr>
<td>VCA angle (degrees)</td>
<td>25</td>
<td>20 to 25</td>
<td>5 to 20</td>
<td>5</td>
<td>Negative</td>
</tr>
<tr>
<td>Head shape</td>
<td>Spherical</td>
<td>Spherical or mild flattening</td>
<td>Flattened or elliptical</td>
<td>Deformed</td>
<td>Deformed with high subluxation</td>
</tr>
<tr>
<td>Congruency†</td>
<td>A</td>
<td>A/B</td>
<td>C</td>
<td>C/D</td>
<td>D</td>
</tr>
</tbody>
</table>

*difference in vertical height †see Figure 1 for details
teric osteotomy was performed first, through an antero-lateral approach, and fixed with a 130° AO blade-plate. The Chiari osteotomy was carried out through a separate incision and stabilised with two thick non-threaded Steinman pins. Additional anterior cover for the head was gained if required by using bone graft from the anterior superior iliac spine.

Early postoperative exercises, both passive and gravity assisted, were instituted and on the fifth day the patient was mobilised. Partial weight-bearing was maintained for six months to give the degenerative joint a good opportunity to recover. Combining the two osteotomies in one operation not only shortens the hospital stay and the period of rehabilitation, but probably also reduces the risk of joint stiffness.

RESULTS

Though all patients had hip dysplasia, the clinical presentation and radiographic signs varied.

Pain. Pain was the main presenting symptom in all patients; 14 had severe pain, 12 moderate pain, and two only mild pain.

At final review ten of the 32 hips (31%) were pain free, 18 (56%) caused occasional mild pain and four (12.5%) caused moderate pain which limited patients' activities.

Functional assessment. Pre-operatively, 18 hips produced a severe limp; at final review two of these still had a marked limp, and the remainder a slight limp. Twelve hips presented with a moderate limp which, at the latest review, had improved to a slight limp in six cases and no limp in the remainder. Two hips presented without a limp and were unchanged at latest review. There was close correlation between a limp and a positive Trendelenburg sign.

A walking aid was required pre-operatively by 14 patients; on latest examination only six used a cane occasionally and the others walked without support. Pre-operatively, walking distance was severely restricted in 12 patients and limited in 16; at their last visit, four patients were unchanged and the rest all improved.

The postoperative range of movement was similar

![Fig 4a](image1)
![Fig 4b](image2)
![Fig 4c](image3)
![Fig 4d](image4)

Figure 4a – Female aged 33, with increasing symptoms in the right hip for eight years. Hip congruency grade C and dysplasia grade III. Degenerative changes grade II. Figure 4b – Faux profile radiograph showing a pathological VCA angle. The femoral head is uncovered in the sagittal plane. Figure 4c – Faux profile one year after the osteotomies demonstrating anterior cover of the femoral head. Figure 4d – Four years after surgery, there is radiological nonunion of the Chiari osteotomy. All radiographic parameters have improved and the clinical result was excellent.
to the pre-operative range. However, by correcting fixed deformities, the intertrochanteric osteotomy allowed these restricted movements to be brought into the functional range.

**Hip score.** The pre-operative Harris hip score averaged 47.4 (range 26 to 80); postoperatively the score was 88 (range 69 to 100, Fig. 3). Twelve hips (37%) had an excellent result, 14 hips (44%) had a good result, five hips (16%) were fair and one (3%) was poor. The latter patient was a 19-year-old woman who had severe dysplasia and degenerative changes. Postoperatively she developed extensive myositis ossificans.

**Leg length.** Pre-operatively 22 patients had leg length discrepancy, ranging from 5 to 45 mm. Intertrochanteric osteotomy allowed limb lengthening in all but a discrepancy persisted in six patients, ranging from 5 to 20 mm.

**Complications.** One patient had a transient sciatic palsy and another a peroneal nerve palsy which recovered fully within six months. There were two instances of radiological nonunion of the pelvic osteotomy, both asymptomatic (Fig. 4). One patient developed heterotopic ossification and a fixed external rotation deformity.

**Patient evaluation.** At final review 22 patients (79%) were very satisfied, four (14%) were satisfied, one was noncommittal and one was dissatisfied.

**Radiographic assessment**

**Dysplasia grading.** According to our classification (Table

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<tr>
<th>CE</th>
<th>VCA</th>
<th>Pre-operative</th>
<th>Final review</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>70</td>
<td>60</td>
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<td>-10</td>
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<td>-40</td>
<td>-40</td>
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**Fig. 5**

Bar chart of CE, VCA and Sharp’s angles (range and mean values), pre-operatively and at final assessment.

Figure 6a – Male aged 31 years with a symptomatic left hip. He had multiple operations during childhood. Hip congruency grade C, dysplasia grade IV, degenerative changes grade III. Figure 6b – The appearance three months after the osteotomies. Note development of a superolateral traction osteophyte. Figure 6c – Seven years later, congruency and dysplasia grading have both improved and degenerative changes have regressed. The Harris hip score was 88.

II) four hips (12.5%) were grade II, 20 hips (62.5%) were grade III and eight hips (25%) were grade IV. The mean values and range of the radiographic parameters of hip dysplasia pre-operatively and at final assessment are summarised in Figure 5.

**Congruency.** There was abnormal congruity in all cases pre-operatively. Grade C incongruency was present in eight hips (25%); three had mildly flattened heads which improved to grade A, and five to grade B. There were 24 hips (75%) with grade D congruity pre-operatively; 16 improved to grade B, six to grade C and two were unchanged. No hip was made worse by surgery and congruency was maintained throughout the follow-up period.

The Chiari osteotomy was intentionally made as low as possible, 0 to 3 mm above the acetabular edge, to ensure loading of the new acetabular roof, and it was directed upward at an average 15° from the horizontal, to avoid entering the joint. Displacement averaged 40% (range 23% to 67%). All hips showed radiographic evidence of loading of the new acetabular roof and 16
(50%) demonstrated radiological evidence of re-moulding of the new roof (Fig. 6).

Secondary arthritis. Secondary arthritis was evaluated by grouping the patients according to the severity of degenerative changes, on presentation and on follow-up (Table II). The hips were further divided according to the length of follow-up (Table III). It may be inferred that those hips with the most advanced degenerative changes tended to show the least radiographic improvement, and were more likely to regress with time. However, the sample is probably too small to draw a definite conclusion.

The average age on presentation with grade I secondary arthritis was 20 years; with grade II, 24 years; and with grade III, 34 years.

DISCUSSION

Among orthopaedic surgeons in the English-speaking world, osteotomies about the hips have the reputation of being complicated to plan and difficult to execute (Heatley 1986).

Studies of the Chiari osteotomy have often been based on retrospective data, a mixture of pathological conditions, patients whose ages ranged from childhood to adulthood, a variety of surgical techniques and other uncontrolled parameters (Colton 1972; Chiari 1974; Hoffman, Simmons and Barrington 1974; Mitchell 1974; Malefijt, Hoogland and Nielsen 1982; Calvert et al 1987; Högh and Macnicol 1987). Reynolds (1986) grouped his adult patients into four categories in increasing order of severity of dysplasia and secondary degenerative change; he concluded that surgery was inadvisable in the more advanced cases. However, our results have been gratifying, despite the high number (56%) of severely dysplastic hips in our series, comparable with Reynolds' most advanced group (category IV).

In our series 81% had deformed femoral heads, some with a lateral prominence. In these, Chiari osteotomy alone would have aggravated eccentric loading by increasing the pressure superolaterally, a problem which is recognised by those surgeons who consider combined osteotomy in such cases (Chiari 1974; Schreiber 1979; Bombelli and Aronson 1984; Maquet 1984; Morsch and Feinstein 1984).

The combined osteotomy improves head cover: laterally by the Chiari osteotomy, and anteriorly by the extension component of the intertrochanteric osteotomy. It also improves congruency by matching the weight-bearing surfaces, and therefore increasing the area available to transmit load.

Pressure across the joint is reduced by the medialisation effect of the Chiari osteotomy. If the femoral head has formed a medial osteophyte (the capital drop osteophyte), intertrochanteric osteotomy allows rotation of this segment of the head into the loaded zone, thus medialisating the weight-bearing area and further reducing the load across the hip.

Limb lengthening, after the valgus correction, causes increased pressure across the hip, which can be reduced by recessing the iliopsoas and displacing the greater trochanter. The osteotomised trochanter is lateralisated by a bone graft to enhance its abductor function.

Should hip replacement be required in the future, this would be facilitated by the augmented acetabular bone stock. The insertion of the femoral component after a displaced intertrochanteric osteotomy is a technical problem which can usually be overcome by proper pre-operative planning. The results of 105 hip replacements performed after previous osteotomy, reported by Benke, Baker and Dounis (1982), compared favourably with primary hip replacement and they concluded that intertrochanteric osteotomy did not prejudice the result.

In forecasting the probable result of combined osteotomy cognisance should be taken of the severity of the condition, scarring after previous surgery, the patient’s disability and the natural history of the untreated condition.

Although, the results may not prove permanent, the medium-term clinical and radiological improvements from the combined osteotomy operation make this procedure worthwhile, particularly when it is weighed against the available alternatives of hip arthroplasty or arthrodesis.

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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REFERENCES


