THE PELVIC OSTEOTOMY OF CHIARI: AN ANATOMICAL STUDY OF THE HAZARDS AND MISLEADING RADIOGRAPHIC APPEARANCES

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The medial displacement osteotomy of Chiari has an established place in the management of older children and adults with severe hip dysplasia. The results claimed for the operation are, however, variable. There have also been reports of sciatic nerve lesions. In this study ten cadavers were operated upon. Chiari osteotomy was performed upon five, and five acted as controls. The hemipelvis was removed from each cadaver; each specimen was deep-frozen and sectioned transversely. The distance of the sciatic nerve from the nearest bony point was measured in each section and the results were recorded graphically. A further radiographic and photographic study was performed to determine whether apparent displacement at the osteotomy might be misleading. The conclusion was drawn that the sciatic nerve is angulated at the osteotomy and further endangered by the risk of bone splintering at the sciatic notch. The radiographic study suggested that some poor clinical results may be explained by a radiological artefact, because there is a tendency for the osteotomy to hinge posteriorly at the sciatic notch opening anteriorly like a book. Radiographs may suggest excellent medial displacement whereas in fact the femoral head is very poorly covered.

The pelvic osteotomy of Chiari (1955) was conceived originally as an alternative to the shelf operation of Lowman (1931), Ghormley (1931) and Gill (1935) for management of the dysplastic hip. In the younger child the Chiari osteotomy has been largely superseded by the procedures of Salter (1961) and Pemberton (1965), which should probably be preferred when the acetabulum retains its growth potential. Salter recommends his innominate osteotomy for children aged between eighteen months and six years with dislocation of the hip; at this stage growth potential is considerable. He stresses, however, that the osteotomy may be useful in patients up to early adult life who have mild subluxation but preservation of joint congruity. Pemberton suggested that twelve years should be the upper age limit for his procedure, as the triradiate cartilage is thereafter too rigid to allow the acetabular roof to be displaced. The Chiari osteotomy is now more used for older children and adults with severe hip dysplasia or paralytic dislocation.

Colton (1972) reported that the results of the Chiari medial displacement osteotomy were variable: he assessed only 66 per cent of the patients he reviewed as having an “acceptable” clinical result. He attempted to relate good clinical results with the amount of displacement achieved radiologically. Hoffman, Simmons and Barrington (1974) and Mitchell (1974) reported more satisfactory results. It seems, however, that radiographs may be open to considerable misinterpretation.

There have been several reports of complications following the different types of pelvic osteotomy (Chiari 1964; Pemberton 1965). These include injury to the sciatic nerve, haemorrhage from the gluteal vessels, technical errors in the level of the osteotomy and in the degree of displacement, non-union, and residual pain.

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By dissection of cadavers we have attempted to demonstrate some of the potential hazards of the Chiari osteotomy, with particular reference to the sciatic nerve. A radiographic and photographic study showed that seeming displacement at the osteotomy may be illusory.

**METHOD**

Ten cadavers were operated upon. Medial displacement osteotomy was performed upon five; the second five acted as controls. A standard Smith-Petersen approach was used. Both sides of the blade of the ilium were exposed; the hip capsule was displayed laterally and the greater sciatic notch posteriorly. The iliac osteotomy was curved over the hip capsule: several osteotomes were used rather than a Gigli saw or reciprocating saw. The level of osteotomy was checked by opening the hip capsule; radiographic control was not used. The osteotomy was directed medially and 10 degrees upwards. The osteotomy was displaced by abducting the leg, and held in place with either a wooden peg or a Steinmann's pin. The hemipelvis was dissected from both the osteotomised and the control cadavers by disarticulation at the sacro-iliac joint and symphysis pubis. The leg was transected fifteen centimetres below the greater trochanter and the specimen removed subcutaneously. Each specimen was then deep-frozen. Radiographs were taken and the specimen was cut into one-centimetre transverse sections: each section was photographed (Fig. 1).

Five sections about the level of the osteotomy were used to demonstrate the relationship of the osteotomy to the sciatic nerve. The distance between the nerve and the closest bony point was measured in each section and compared with comparable sections cut through the control specimens. The results were recorded graphically (Figs. 2 and 3). A three-dimensional Perspex model was constructed to demonstrate the passage of the nerve through the sciatic notch in the osteotomised cadaver.

A normal innominate bone was cut in the manner of the Chiari osteotomy. Its traced outline is shown in Figure 4. The os innominatum was mounted in a stand and displaced at the osteotomy site in one of two different ways: in the first, displacement was truly medial; in the second, the osteotomy was hinged posteriorly at the sciatic notch, opening anteriorly like a book. Radiographs and photographs were taken with each type of displace-
Os innominatum with Chiari osteotomy performed, with true medial displacement. Radiographs (above) and photographs taken as the innominate bone was rotated through arcs each of 10 degrees.

FINDINGS

Although the cadavers operated upon clearly did not have hip dysplasia, certain conclusions may nevertheless be drawn from the experiments. The upward reflection of the capsule of the hip on the ilium may be extensive: if the capsule is not to be opened, radiographs must be taken during the operation to show accurately the level for osteotomy (Waigand 1965). Even with direct vision, the amount of displacement at the osteotomy may be difficult to gauge. Furthermore, there is a tendency for the osteotomy to displace incorrectly in two planes. Despite curving the osteotomy in the antero-posterior plane, the distal pelvic fragment tends to move backwards. This is of less practical importance, however, than the
Os innominatum with Chiari osteotomy performed; the osteotomy hinges incorrectly at the greater sciatic notch posteriorly. Radiographs and photographs taken as the innominata bone was rotated through arcs each of 10 degrees.

Two factors may contribute to the vulnerability of the sciatic nerve. Figure 3 shows that angulation of the nerve occurs at the level of the osteotomy, and this alone may explain the neurapraxia occasionally seen. During the osteotomy it was often found that the inner pelvic table tended to splinter, particularly at the sciatic notch. This combination of angulation and splintering further increases the possibility of nerve injury. If, as sometimes happens, the distal pelvic fragment slips posteriorly at the osteotomy site, the sciatic nerve is slightly relaxed and therefore protected.

Radiographs may be misleading. Bilateral Chiari osteotomy was performed for a woman aged thirty-three with painful dysplastic hips (Figs 7 and 8). Radiographs appeared to show excellent displacement.
with satisfactory femoral head "cover". The hip was surgically re-explored and it was apparent that displacement had occurred by hinging at the sciatic notch. This hinge displacement is difficult to demonstrate radiologically; the open face of the iliac wing is the most reliable guide. Comparison with pre-operative radiographs may demonstrate that the distal pelvic fragment has rotated inwards. Oblique radiographs may show an unbroken curve at the sciatic notch.

The outline sketch (Fig. 4) of the sectioned pelvis demonstrates that even with 50 per cent medial displacement only 1-5 centimetres of femoral head cover is provided. The radiographs and photographs in Figure 6 show how misinterpretation may occur: the "hinged" osteotomy gives the illusion of excellent head cover, whereas dissection shows that it gives very little. When true medial displacement occurs the radiographs may appear less impressive, but the cover provided is true cover for the femoral head.

CONCLUSIONS

Medial displacement osteotomy of the pelvis may lead to sciatic nerve injury: the nerve is angulated at the osteotomy site, and splintering of bone at the sciatic notch is common. The nerve may be retracted safely by using interlocking small-bladed cobra retractors. The amount of cover provided by the osteotomy is small. With 50 per cent displacement only 1-5 centimetres of cover is provided in the adult. Radiological appearances may be misleading. Seemingly excellent cover may be given when the osteotomy hinges posteriorly, whereas the actual cover is small.

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REFERENCES