Transtrochanteric valgus osteotomy for the treatment of osteoarthritis of the hip secondary to acetabular dysplasia

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Our study describes the mid-term clinical results of the use of transtrochanteric valgus osteotomy (TVO) for the treatment of osteoarthritis of the hip secondary to acetabular dysplasia. The operation included valgus displacement at the level of the lesser trochanter, and lateral displacement of the greater trochanter by inserting a wedge of bone. We reviewed 70 hips. The mean age of the patients at operation was 44 years (14 to 59). Most (90%) had advanced osteoarthritis.

The scores for pain and gait had improved significantly at a mean follow-up of 9.4 years. The rate of survival until an endpoint of a further operation during a follow-up of ten years was 82%. The survival rate was 95% in patients with unilateral involvement who were less than 50 years of age at operation. TVO is a useful form of treatment for advanced osteoarthritis of the hip, particularly in young patients with unilateral disease.

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Total hip arthroplasty (THA) in young patients has a high rate of failure in the long term. Although the results are encouraging in young patients with rheumatoid disease, they are much worse in young patients with degenerative arthritis, particularly when it is secondary to acetabular dysplasia. Recent studies have suggested that the long-term survival of THA in young patients is similar to that in the elderly, but the former have a higher requirement for revision procedures. A high rate of failure in young patients has been reported after revision arthroplasty. For these patients the requirement for revision procedures may be reduced either by increasing the survival rate of primary THA or by selecting another form of surgical treatment.

In 1984, Sugioka developed a transtrochanteric valgus osteotomy (TVO) for advanced osteoarthritis of the hip in young patients, carried out at a lower level than the subtrochanteric osteotomies described by Pauwels and Bombelli, Gerundini and Arson. Concomitant lateral advancement of the greater trochanter causes lengthening of the lever arm, resulting in improved biomechanical function of the joint. Our study describes the osteotomy and reports the mid-term clinical findings.

Patients and Methods

The operation was carried out in patients less than 60 years old with advanced osteoarthritis of the hip because of acetabular dysplasia. The required preoperative range of movement in flexion and extension was >60°, with a range of adduction of 15°. A well-developed medial osteophyte (the so-called capital drop) was usually present on the femoral head when there was hinge abduction and good joint congruity in adduction.

An intertrochanteric osteotomy was carried out with valgus displacement of the proximal femoral fragment and lateral displacement of the greater trochanter by inserting a wedge of bone between the greater trochanter and the proximal femoral fragment (Fig. 1). These procedures produce an increase in the area of weight-bearing of the hip and a reduction of forces across the hip by altering the lever arm of the abductor muscles and by the medial displacement of the mechanical centre of the femoral head.

Preoperative anteroposterior (AP) radiographs of both hips at maximum adduction and abduction are required. In maximum adduction, widening of the superolateral joint space and better congruity of the joint are encouraging features when selecting TVO as a suitable form of treatment. A preoperative arthrogram will predict an improvement of the congruity of the hip after TVO. A decrease of pooling of the contrast medium between the femoral head and acetabulum in the adducted position indicates better congruity. Hinge abduction is another encouraging feature.

The valgus angle to be used was determined by the maximum angle of adduction. It was usually the maximum
angle plus 5°. The outline of the acetabulum and the proximal part of the femur was traced on paper, the predicted outline of the hip after TVO was constructed, and the predicted value for the acetabular head index after osteotomy recorded. When the index of the head cover was less than 60%, additional acetabuloplasty was required and these hips were excluded from this study.

Between 1983 and 1990, we performed TVO on 72 hips in 66 patients for the treatment of osteoarthritis secondary to acetabular dysplasia. Two patients were lost to follow-up leaving 70 hips (97%) for review. The latest clinical information for most hips was obtained from the hospital records and in some by telephone interview. The mean follow-up was for 9.1 years (2 to 15). There were 57 women and seven men with a mean age at the time of operation of 44 years (14 to 59). Seven hips had early and 63 advanced osteoarthritis. The radiographs in early osteoarthritis showed slight narrowing of the joint space with occasional cystic and sclerotic changes; those of advanced osteoarthritis showed marked narrowing of the joint space with gross cystic and sclerotic changes. The mean Sharp angle was 45° (37 to 60). The grade of subluxation of the femoral head was Crowe type I or II. In 36 patients there was bilateral disease, and in 24 of these operation on the other hip was undertaken either just before or just after TVO. This operation was varus osteotomy in four, valgus osteotomy including TVO in 14, anterior rotational osteotomy in one, and THA in five patients. The remaining 28 patients had unilateral involvement. The mean valgus angle was 19° (15 to 25).

**Operative technique.** With the patient in the lateral position, a lateral approach was employed with osteotomy of the greater trochanter. The plane of the osteotomy of the greater trochanter was perpendicular to the sagittal plane of the femur. With the limb in internal rotation, the posterior aspect of the hip was exposed. The lesser trochanter was exposed in order to protect the nutrient vessels to the femoral head which run beneath quadratus femoris. The osteotomy was carried out at the level of the proximal aspect of the lesser trochanter and the lines marked with a chisel using a template. The proximal line should be at least 1 cm distal to the intertrochanteric crest in order to prevent injury to the nutrient vessels. The osteotomy was completed and the resulting wedge of bone removed. Valgus displacement was achieved by abducting the distal femoral fragment. The proximal aspect of the femur was fixed by two or three Venable screws. The greater trochanter was reattached to the distal femoral fragment with wire. We placed the wedge-shaped fragment of bone between the greater trochanter and the surface of the femur. The wiring technique required two holes, one anterior and one posterior, to be drilled in the greater trochanter and the wedge-shaped fragment. Another hole was drilled in the distal femoral fragment. A wire 1 mm in diameter was passed through the greater trochanter and the fragment of bone, and through the hole in the distal femoral fragment. Two free ends of the wire were tightened over the greater trochanter.

Partial weight-bearing began five weeks after operation, and full weight-bearing after three to four months.

Pain and mobility were classified using the scoring system of Merle d’Aubigné and Postel as modified by Charn-
The mean preoperative scores for pain and walking ability were 2.4 (1 to 4) and 3.0 (1 to 5), respectively. At a mean period of 6.6 years (2 to 12) after TVO 13 hips (19%) underwent a further operation, either THA (12 hips) or arthrodesis (1). In the hips which did not require further surgery, the mean pain and walking scores were 4.6 (2 to 6) and 4.3 (2 to 6) at a mean period of 9.4 years (3 to 15) after TVO, a significant improvement ($p < 0.0001$, paired $t$-test).

The survival rates of TVO at a follow-up of ten and 15 years were 82% and 72%, respectively (Table I). There was a tendency (Mantel-Cox log rank, $p = 0.119$) for TVO in patients with unilateral and bilateral involvement, respectively. In those who were less than 50 years of age at operation, the survival rate was significantly higher than in those with both hips affected (Table I). The survival rates of TVO at a follow-up of 15 years were 88% and 52% in patients who had unilateral and bilateral involvement, respectively. In those who were less than 50 years of age at operation, the survival rate was significantly higher than in those who were ≥50 years of age at operation (Mantel-Cox log rank, $p < 0.03$; Table I). The survival rates at follow-up at ten years were 91% and 62%, respectively. In patients with unilateral involvement and who were less than 50 years of age at operation, the survival rate at follow-up of 15 years was 95% (Table I).

The radiological signs of osteoarthritis were improved after TVO in most hips. Bone sclerosis or cysts in the acetabulum or femoral head regressed and regeneration of articular cartilage at the weight-bearing area with widening of the joint space was seen (Fig. 2). Within three years of surgery 46 of 63 patients (73%) had widening of the joint space and 48 of 63 (78%) showed a decrease in sclerosis or cysts in the acetabular roof; at more than ten years after TVO, these improved radiological signs were still seen in 13 of 30 (43%) and 12 of 30 (40%) of the hips, respectively. Eight hips (11%) had nonunion or fibrous union of the greater trochanteric osteotomy. None required operative reattachment. No cases of postoperative pulmonary embolism or deep infection were recorded. One patient was treated with a hip spica for a month because of a suspected femoral fracture. Of the 18 patients with bilateral involvement, but no surgery on the contralateral hip, the osteoarthritis in the contralateral hip worsened in eight (44%).

**Discussion**

TVO has many advantages compared with other techniques for subtrochanteric valgus osteotomy. Both the operation described by Pauwels and the modified method of Bomelli et al require rigid fixation because of the small area of contact at the site of the osteotomy which may lead to an inaccurate angle of correction. By contrast, a TVO involves a good contact area with abundant cancellous bone at the site of the osteotomy, and early bony union may be expected. This allows a simple technique of fixation to be used. Deformity at the site of the osteotomy may prevent the insertion of a standard femoral component if THA was required later. By contrast, TVO is carried out at a level proximal to the lesser trochanter, and does not result in subtrochanteric deformity. A standard femoral component may be inserted later if required. Lateral displacement of the abductor force by insertion of a bony wedge within the greater trochanter reduces the resultant loading on the femoral head.

TVO resulted in improved mobility in most hips. In those with hinge abduction, valgus displacement of the proximal fragment caused a change in the range of movement of the hip with increased abduction. The pain caused by hinge abduction during the stance phase of gait was eradicated. The pain score decreased in most hips (81%) within three years of operation and it remained more than two points higher than that before operation in 68% of hips at the latest clinical evaluation.

Several studies have reported that osteotomy leads to better results in patients with unilateral disease, and this was confirmed in our study. Osteoarthritis progressed in some of the contralateral hips and this was associated
with a decreased survival of the TVO. Bilateral TVO is not recommended for patients with advanced bilateral disease.

TVO in relatively young patients (less than 50 years old) survived significantly longer than in those who were ≥50 years old, as has been generally reported for osteotomy.17-19

The hips in our study were not specially selected. The survival rate of TVO in patients under 50 years old and who were unilaterally involved was high. Patient selection may improve the long-term results for TVO as with other osteotomies.18,19 We suggest limiting the use of the procedure to patients who are young and have unilateral disease.

This operation does not include an extension component as does the valgus osteotomy of Bombelli et al.12 which allows a biplanar correction. The results after a single-plane TVO have been as good as those after biplanar osteotomy.20 Biomechanical analysis using a rigid-body spring model21 has shown that the lateral displacement of the greater trochanter and the medial displacement of the weight-bearing area result in a decrease in the load on the hip. In addition, valgus displacement of the femoral head equalises the distribution of contact pressure. In many hips,
the radiological appearances improved, suggesting that TVO improved the biomechanical function of the osteoarthritic hips. Another biomechanical analysis\(^{21}\) showed that TVO has no significant effect on the ipsilateral knee. Although the mechanical centre of the femoral head was displaced medially by the osteotomy, this shift antagonised the geometrical lateral shift of the femoral head leading only to small changes in the position of Mikulitz’s line.

Realignement of the loading of the articular cartilage and subchondral bone improved the biomechanical conditions and resulted in regeneration of articular cartilage in many joints, but these effects gradually decreased with the passage of time. Two reasons for this should be considered. First, the acetabular dysplasia remains, and for hips with severe dysplasia, additional acetabuloplasty will be required. Secondly, the regenerated cartilage is fibrocartilage, such as hyaluronic acid and growth factors, have become available and adjuvant treatment with those agents may improve the clinical results and expand the indications for TVO. For patients with unilateral involvement of the hip and who were less than 50 years of age at operation, the mean postoperative pain and mobility scores were 4.4 and 4.3 at a mean period of 10.4 (3 to 15) years after TVO (data not shown). These results are similar to those after THA. The long-term results of THA for osteoarthritis of the hip secondary to acetabular dysplasia or congenital dislocation include survival rates, with revision and radiological loosening as the endpoints, of 85% and 68% at 15 years, respectively.\(^6\) The survival rate of TVO until an endpoint of a further operation is similar. TVO causes no deformity in the subtrochanteric region of the femur, and a standard THA can be done as a further operation. TVO should be considered when treating advanced osteoarthritis secondary to acetabular dysplasia in young patients.

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References