Isolated varus intertrochanteric osteotomy for hip dysplasia in 52 patients: long-term results

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Abstract Great strides have been made in the field of total hip arthroplasty, but the issue of wear and osteolysis continue to be a problem, mostly for young adults. For this population varus rotational osteotomy still remains a viable alternative to total hip arthroplasty. The purpose of this prospective study was to describe the indications, the technique and the functional outcome of an isolated varus femoral osteotomy in 52 patients with hip dysplasia. We obtained very good results with a significant improvement of hip function and pain relief. We conclude that with appropriate selection of the patient the procedure may prevent or postpone the development of secondary osteoarthritis.

Résumé De nombreux problèmes ont déjà été étudiés dans le champ de la prothèse totale de hanche, néanmoins, le problème de l'usure et de l'ostéolyse continue à être un problème important chez l'adulte. L'ostéotomie de varisation dérotations reste une alternative acceptable dans le traitement de ces lésions. Le but de cette étude est de réaliser une étude prospective afin de décrire les indications, la technique et le devenir fonctionnel de ces patients. Parmi les 52 patients

opérés avec dysplasie cotyloïdienne nous pouvons rapporter de très bons résultats avec une amélioration de la fonction de la hanche et une amélioration des phénomènes douloureux. Après une sélection appropriée des patients ce traitement peut prévenir le développement trop précoce d'une arthrose secondaire à une dysplasie.

Introduction

Developmental hip dysplasia remains a common cause of secondary osteoarthritis of the hip and may be a primary cause of disability in young and active patients [7]. The term acetabular dysplasia is used to describe poor coverage of the superior and anterior part of the femoral head and a reduction of the acetabular femur depth [23]. Total hip arthroplasty, which was introduced in the 1960s, is to date the most successful procedure in modern medicine. However, for young and active patients the results are not favourable, as the risk of loosening and revision is high [6, 11]. An alternative and attractive therapeutic option in young patients with early osteoarthritis is the hip osteotomy.

The beneficial role of intertrochanteric varus or valgus osteotomy in the treatment of hip osteoarthritis has been recognized since the 1920s [2]. Pauwels was the first to describe the specific mechanical abnormalities that are present in the hip with developmental dysplasia and to support the role of the mechanical environment in the aetiology of osteoarthritis [15]. Indeed, many cases of osteoarthritis are caused by mechanical deformity, and if the mechanical abnormality is corrected in a timely fashion, the osteoarthritis may be prevented [12]. The rationale of hip osteotomies, pelvic or femoral, is to improve the mechanical environment and the joint congruency before

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Fig. 1 The guide set at the necessary correction angle according to the preoperative plan

the patient is very symptomatic. Theoretically, most of the beneficial effects of the osteotomies are believed to be the result of a reduction of the load and stress on the hip [13]. Additionally, it has been postulated that the damaged cartilage is repairable if the load and stress can be reduced [14].

The purpose of this study was to review the preoperative planning, the technical aspects and the results of varus derotational intertrochanteric osteotomy in 52 patients with hip dysplasia. Furthermore, we sought to determine the complications and outcomes, using both clinical (such as the hip scoring system) and radiographical measures.

Materials and methods

The study cohort consisted of 52 consecutive patients who, between 1990 and 2000, had been evaluated at the outpatient clinic of a University tertiary care centre and had subsequently undergone varus derotational intertrochanteric osteotomy for hip dysplasia. There were 44 females and eight males, and the mean age was 38.12 years (range: 29–57 years; SD: 7.401). All procedures were performed by the same surgeon. The authors who reviewed the patients had not taken part in the surgery.

The indications for varus intertrochanteric osteotomy were superolateral arthritis Grade I (mild loss of the joint space and minimum formation of osteophytes) or grade II (small cysts in the femoral head, moderate loss of the joint space) (Tonnis classification [21]), spherical femoral head, significant coxa valga, improved radiographic appearance of congruency in the new position and a minimal abduction of 15°. Fifty one patients were classified as Grade I and one patient as Grade II. The mean neck-shaft angle was 144.23° (range: 140–150°; SD: 3.191) and the mean centre edge angle was 19.98° (range: 18–22°; SD: 1.129). Clinical evaluation was done

using the D'Aubigne-Postel scale. The preoperative score was 12.81 (range: 11–14; SD: 0.742).

The preoperative planning included an AP radiograph, a true lateral of the hip, an AP radiograph with the hip in an abducted position and a scanogram to evaluate the mechanical axis of the limb. The degree of varus correction was determined using computer software (Adobe Photoshop) where the surgery was simulated by the surgeon.

Surgical technique

The preferred technique was one which did not involve the removal of a wedge of bone from the osteotomy site in order to avoid limb shortening. A lateral approach was used. The capsule was opened, and guide wires were inserted into the inferior half of the femoral head, followed by the insertion of the chisel through the distal part of the trochanteric bed. The guide was set at the necessary correction angle according to the preoperative plan (Fig. 1). The femoral osteotomy was performed without removing a wedge of bone. For fixation of the osteotomy an L plate 90° with five screws was used in all cases. The plate was removed 2 years after the index operation in all patients.

All of the postoperative radiographs were evaluated to assess any changes to the joint space, sclerosis, osteophytes, congruency and collapse of the head. All patients were followed-up postoperatively with annual clinical and radiographical examinations.

The main outcomes of this study were the subcomponents of the D'Aubigne scale (pain, stiffness and walking) at the last follow-up assessment and the need for postoperative total hip replacement.

In order to compare pain, stiffness and walking abilities before and after surgery we used Student's one sample *t*-test. The Kaplan Meier method was used to graph survivorship curves, and we applied Cox proportional hazards modelling to identify potential predictors of poor outcome. We defined the radiographic deterioration of the joint space and the need for total hip replacement as 'failure'. Cases were identified at their last follow-up visit if no total hip replacement was deemed necessary. We simultaneously included age, gender, preoperative grade of hip dysplasia, femoral head sphericity, center edge angle, joint congruency in abduction position and pain as potential predictors of failure. Statistical analyses were carried out using SPSS ver. 12 statistical software (SPSS, Chicago, Ill.).

Results

All of the patients were mobilised by the physiotherapist on the second postoperative day. They remained partial weight

Table 1 The radiographic evaluation

	<i>n</i>	Minimum	Maximum	Mean	Standard deviation
Age (years)	52	29	57	38.12	7.401
Correction (°)	52	10	40	15.52	3.822
Neck-shaft angle preoperatively (°)	52	140	150	144.23	3.191
Neck-shaft angle postoperatively (°)	52	125	135	128.37	3.087
Follow-up (years)	52	5	15	10.98	2.322
Valid (<i>n</i>)	52				

bearing on the operative side for 6 weeks and then progressed to full weight-bearing with one crutch until clinical and radiographical full union. Low-molecular-weight heparin was given for 4 weeks. The mean varus correction was 15.87° (range: $10\text{--}25^\circ$; SD: 2.368) and the mean neck-shaft angle was 128.37° (range: $125\text{--}135^\circ$; SD: 3.087) (Table 1).

The patients were seen postoperatively at 6 weeks, 3 and 6 months and then annually with repeated clinical assessments and radiographs. The mean follow-up period was 10.98 years (range: 5–15 years; SD: 2.322). No patient was lost to follow-up. The mean time of union was 4.21 months (range: 3–6 months; SD: 0.605). There was no mal-union or non-union. There was no limb shortening. However, during the first 12 postoperative months 36 (67%) patients complained of fatigue limp and minimal weakness during prolonged walking. Clinical assessment determined the presence of abductor lurch in these patients. Intensive physiotherapy was suggested with an emphasis on strengthening the abductors, with success as the complaint

disappeared within the first year of therapy. A bulge from the prominence of the greater trochanter as a result of varus positioning was noticed and reported by all patients. The mean postoperative D' Aubigne score was 15.88 (range: 15–16; SD: 0.323; $p<0.0001$).

The postoperative radiographs of 50 patients were unchanged. Two patients—one female and one male—had total hip replacement. The female patient, who had dysplasia grade I, had a varus osteotomy when she was 35 years old. The varus correction was 15° (Figs. 2, 3, 4). Total hip replacement was performed 9 years later. The operation prevented further progression of the osteoarthritis, but the patient was never free symptoms, although they occurred at a lower intensity. The male patient was 57 years old at the time of the osteotomy due to dysplasia grade II. He had radiographic deterioration and clinical signs of

Fig. 2 Hip dysplasia with arthritis grade I in a 35-year-old female **Fig. 3** The same patient as in Fig. 1 after the femoral osteotomy

Fig. 4 The same patient as in Fig. 1 9 years after the surgery

severe osteoarthritis. He had a hip replacement 8 years after the osteotomy.

Survival analyses

The Kaplan Meier curve is presented in Table 2. In the analytical approach participants were considered to be failures when total hip replacement had been carried out. Survival (failure-free) probability was 98% at 8 years and 93% at 9 years. None of the variables included in the Cox models was proven to be a significant predictor of failure: age ($p=0.502$), gender ($p=0.940$), side ($p=0.466$), angle of correction ($p=0.997$), center edge angle ($p=0.544$), preoperative pain ($p=0.525$), preoperative walking ($p=0.898$) and preoperative mobility ($p=0.891$).

Table 2 Kaplan Meier survival analyses defining as failure the time for total hip replacement

Discussion

We present data on the technique and the long-term clinical outcomes of varus intertrochanteric osteotomy in young patients for hip dysplasia. All of the patients had poor superior and anterior coverage of femoral head, antero-supero-lateral localised pressure, spherical femoral head and mild or moderate (one patient) loss of joint space. Femoral osteotomy for osteoarthritis of the hip has been carried out since the 1920–1930s [2, 24]. Between 1970 and 1980 total hip replacement was the first choice of many surgeons, and femoral osteotomy was partially abandoned. However, various studies have indicated that the results of total hip replacement in young patients are not favourable [3, 6, 11].

Bombelli developed a useful mechanical model for depicting the abnormal mechanical situations that are the causative factors in hip arthrosis [1]. Joint preserving procedures for young patients are more valuable today than ever, not only as a means to prevent osteoarthritis but also to treat it by reducing the mechanical overload [14]. Realigning varus or valgus osteotomies of the proximal femur are the most well established joint-preserving procedures applied [20]. The rationale for these procedures is the reduction of stress throughout the cartilage surfaces in a hip that is compromised mechanically [2].

The most common indication for femoral osteotomies has been developmental dysplasia [20]. The incidence of true dysplasia is unknown, and the natural history in the absence of subluxation and with intact Shenton's line is difficult to predict [16, 23]. However, Harris has reported that once pain and roentgenographic degeneration start, they progress rapidly [7]. The only roentgenographic feature present at the onset of symptoms may be the increased sclerosis in the weight-bearing area [15]. According to Wiberg, there is an association between the onset of roentgenographic degenerative joint disease and the decrease in the centre edge angle [25]. Conversely, Cooperman et al. have reported that the decrease of the centre edge angle can not predict the rate at which the hip joint will develop degenerative joint disease [4]. Nevertheless, there is consensus by many authors that although it is difficult to predict the natural history of hip dysplasia, there is definite association between dysplasia and degenerative joint disease [4, 23].

Although the deformity is on acetabular side in hip dysplasia and, consequently, pelvic osteotomies might be more appropriate in these patients, intertrochanteric osteotomy remains a valuable and simple procedure with lower morbidity in patients with grade I dysplasia [12, 18, 19]. However, some authors have reported that the outcomes of an osteotomy are unpredictable [12, 18, 19].

A review of the literature shows that varus femoral osteotomy has been less effective only in patients with grades II and III dysplasia, with loss of femoral

sphericity and established osteoarthritis [5, 9, 22] but, this same procedure has been shown to result in favourable outcomes in patients with grade I dysplasia, with a spherical femoral head and good range of motion preoperatively [9, 10, 17].

The results obtained by the varus femoral osteotomy in this study are very encouraging. The postoperative long-term clinical outcome was very good in almost all patients. Although during the first year many patients had complaints of fatigue and limping (abductor lurch), this was only a temporary problem: in subsequent follow-up visits the symptoms had disappeared and patients had no further complaints. We therefore recommend that the surgeon should inform patients about the possibility of such symptoms during the first year and about the transient nature of these symptoms.

Better results have been found to occur when a femoral osteotomy was carried out in patients with congenital dysplasia of the hip (CDH) and early osteoarthrotic changes [13, 16, 17, 20]. Hess et al. [8] reported the results of 22 patients (33 hips) with CDH treated with combined acetabuloplasty and varus derotation osteotomy after a long follow-up of 26 years (range: 19.7–28.4 years). Based on clinical assessment, the authors reported favourable results in 85% of cases. Of particular interest is that these authors believe that the varus derotation osteotomy was necessary for proper correction of the deformity – even though they themselves had used acetabuloplasty. Perla et al. [17] reported the results of 18 isolated femoral osteotomies (ten varus) in 17 patients with CDH. The mean follow-up was 6.1 years. Their results were less satisfactory in patients with a greater degree of dysplasia and advanced osteoarthrotic changes. These authors suggested that isolated femoral osteotomy should be carried out in patients with dysplasia grade I and early osteoarthrotic changes. Ito et al. [9] reported the results of 55 intertrochanteric varus osteotomies in 46 patients with hip dysplasia. The mean follow-up was 17 years. They judged their results to be acceptable only in patients with good spherical femoral head and dysplasia grade I. In addition, the authors described only 42% of the results to be acceptable in patients with severe dysplasia grade II–III and degenerative changes II–III. They also suggested that the varus femoral osteotomy might not be indicated for these patients. Iwase et al. [10] described 52 varus femoral osteotomies in 42 patients with dysplastic hips grade I–II and with a mean follow-up of 21 years. He reported an 87% survival rate 15 years after the operations, using as end point the Harris Hip Score <70 points or total hip replacement. Pellicci et al. [16] reported the results of 48 patients with hip dysplasia treated with varus femoral osteotomy. The mean follow-up was 9.6 years, and the mean age of the patients was 33 years. The average time before revision was 8.6 years.

Forty hips (72%) were rated excellent and good. Thirteen hips (23%) had been revised to total hip replacement during an average follow-up period of 8 years. The authors reported that the patients with less advanced disease had better results.

Our results are consistent with those reported in the literature. Using Kaplan-Meier's method (end point total hip replacement), we obtained a 15-year survival rate of 96.5%. The postoperative functional outcome was also very good. One reason for the favourable results of this study was probably due to the very strict selection of patients. Our indications for isolated varus femoral osteotomy were: (1) dysplasia grade I, (2) spherical femoral head, (3) good congruency of the femoral head in the abducted position, (4). major deformity on the femoral side and none on the acetabular side, (5) patient younger than 60 years old. All our patients but one satisfied these inclusion criteria. The one exception was a patient with dysplasia grade II, with narrowing of the joint but a spherical femoral head. Even though he eventually underwent total hip replacement 8 years after the osteotomy, he was able to function well for those 8 intervening years. An issue which should concern the surgeon is the leg shortening that some authors have reported to result from the procedure [16, 20]. Clinical and radiographical evaluation did not reveal any significant leg shortening among our patients and, in addition, no patient complained of leg shortening. Consequently, we believe that the technique described herein in which a wedge of bone is not removed is reliable and safe with respect to discrepancies in leg length.

Patients with dysplastic hips may have vague groin pain or greater trochanteric pain that has been treated for years as a groin or trochanteric bursitis. We believe this is the challenging point of hip osteotomy. Following a complete evaluation of the patients it is difficult to persuade them that they need this type of reconstructive surgery to prevent osteoarthritis.

Although a pelvic osteotomy may be a more rational procedure for this group of patients, we believe that the varus femoral osteotomy – if the above indications are adhered to – remains a simple and safe procedure with low morbidity, even when carried out in less sophisticated centres. In addition, it is clear from the above discussion that femoral varus osteotomy predictably relieves pain and may delay or postpone total hip replacement.

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