Arthrodiastasis of the Hip

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Background: Hip distraction in Legg-Calvé-Perthes disease unloads the joint, which negates the harmful effect of the stresses on the articular surface, which may promote the sound healing of the areas of necrosis.

Methods: Nonarticulated arthrodiastasis without soft tissue release using an Ilizarov external fixator was applied to 29 patients with Legg-Calvé-Perthes disease (older than 8 y at onset and lateral pillar type C or B).

Results: Follow-up period ranged from 2.5 to 11 years with an average of 7.5 years. Twenty-seven cases (93%) had improvement of the range of motion postoperatively. Preoperatively, all patients had constant pain, whereas at last follow-up 26 (86%) patients had no pain and 3 had an improvement. Stulberg classification was applied to 21 cases who reached skeletal maturity at last follow-up: 9 cases were type II, 7 cases were type III, 4 cases were type IV, and 1 case was type V.

Conclusions: Nonarticulated hip distraction without soft tissue release seems to be a valid treatment option in cases with Legg-Calvé-Perthes disease where poor results are expected from conventional treatment.

Key Words: Legg-Calvé-Perthes disease, arthrodiastasis, no soft tissue release

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Treatment of Legg-Calvé-Perthes disease is a controversial issue.¹ The results for treatment of patients with age of onset >8 years of age tend to be less favorable than the younger age. Greater involvement of the lateral pillar of the femoral head carries the risk of poor prognosis. Besides, marked restriction of hip motion precludes the application of osteotomies for management. Arthrodiastasis is a relatively new method of treatment. It does not change the anatomy of the joint. It provides unloading of the joint, which negates the harmful effect of the stresses on the articular surfaces, which may promote the sound healing of the areas of necrosis.¹

Arthrodiastasis usually describes articulated distraction and often open surgery of the hip as a treatment of a variety of conditions such as avascular necrosis, osteoarthritis, and chondrolysis.² The indications of arthrodiastasis had been extended to include cases with Legg-Calvé-Perthes disease where poor results were expected from other treatment modalities.³ However, soft tissue release was performed in most cases, in addition to articulated distraction. We have been applying this method since 1992, but we observed that some patients who had severe pain refused to mobilize the operated hip. In fact, this was static hip distraction. Moreover, we could not clarify from the literature the validity of soft tissue release or its long-term effect on sports activities. In this study, we reviewed the literature highlighting the indications, results, and complications of arthrodiastasis in Legg-Calvé-Perthes disease. Besides, we report our midterm results after application of nonarticulated arthrodiastasis without soft tissue release.

METHODS

From 1995 till 2007, 33 cases with Legg-Calvé-Perthes disease were treated with nonarticulated joint distraction in our institution. Four cases were excluded due to inadequate follow-up data.

The inclusion criteria were as follows:
1. Age above 8 years.
2. Herring lateral pillar classification type B or C.
4. Severe pain.
5. One or more Catterall head at risk signs.⁴ The age of patients ranged from 8 to 14 years (4 cases were 12 y or older). There were 22 boys. All the cases were unilateral. Four patients had previous operations (Fig. 1).

The operative treatment included the application of an Ilizarov external fixator to the pelvis and the femur. Two or 3 Schanz screws of 5 mm or 6 mm in size were applied to the supra-acetabular area and fixed to 90 degrees arch. One and half rings were applied to the femur using 1.8 mm tensioned wires in addition to the Schanz screws. The frame was connected while the femur is abducted approximately 15 degrees. After 3 days, gradual distraction started at a rate of 1 mm per day till over correction of Shenton line by 5 to 10 mm. The patients were encouraged to walk with partial weight bearing using 2 elbow crutches immediately after the operation. We did not perform any soft tissue release for all patients. External fixation time ranged from 2.5 to 5 months. All the hips were graded as C Herring classification, except 5 cases that were graded as B. There were 13 group III hips and 16 group IV hips according to...
the Catterall classification. We have been able to apply Salter and Thompson classification to 24 cases, and 19 of them were B group.

After fixator removal, the patients had daily physiotherapy with passive continuous and active-assisted movement, hydrotherapy with non-weight-bearing mobilization for 2 months and then progressive weight bearing and physiotherapy for 2 more months. The patients were assessed clinically and radiographically before the operation, after the operation, every 1 week till the end of distraction, then every 3 weeks till removal of the fixator, every 1 month for 6 months, and finally every 6 months. Clinically, the presence and degree of pain, range of motion, functional activity level, and satisfaction of the patient were recorded. Stulberg classification was applied to the patients who reached skeletal maturity at last follow-up.

Pain was graded as no pain; mild pain; intermittent pain, which developed after exercises; moderate pain, which developed after regular activities; and severe pain, which is constant pain deserving the regular use of pain killers. The joint space was measured before and after the operation. The sphericity of the femoral head was evaluated at follow-up by Mose concentric rings.

RESULTS

The follow-up period ranged from 2.5 years to 11 years with an average of 7.5 years. Twenty-seven cases (93%) had improvement of the range of motion postoperatively. Preoperatively, all patients had constant pain, whereas at last follow-up 26 (86%) patients had no pain and 3 had an improvement.

Preoperatively, the average hip flexion was 40 degrees (range, 0 to 65 degrees), whereas at last follow-up it improved to 80 degrees (range, 0 to 120 degrees). All patients were satisfied with the results, except 1. The average joint space before surgery was 2.4 mm (range, 1 to 4 mm) and at the last follow-up it was 4.2 mm (range, 2 to 7 mm). At the last follow-up, 15 cases had spherical femoral head (deviation of <2 mm), 9 cases had deviation between 2 and 4 mm, and 5 cases with >4 mm deviation. Stulberg classification was applied to 21 cases who reached skeletal maturity at last follow-up of which 9 cases were type II, 7 cases were type III, 4 cases were type IV, and 1 case was type V. For the 4 cases of adolescent Legg-Calvé-Perthes disease (age >12 y), there were 1 case of type III, 2 cases of type IV, and 1 case of type V.

Complications

Pin track infection developed in 22 cases. Treatment with parenteral antibiotics and more frequent dressing was enough in all cases except 1, which required premature removal of the fixator after 2.5 months due to severe infection of the acetabular pins. There was marked knee stiffness in 2 cases on fixator removal, which
resolved completely with physiotherapy. Chondrodiastasis occurred instead of arthrodiastasis in 1 patient aged 14 years with resultant lengthening of the femoral neck (Fig. 2). Hip subluxation developed in 1 case 1 year after fixator removal, but the femoral head was contained at last follow-up with almost full range of movement and no pain.

DISCUSSION

The aim of treatment of Legg-Calvé-Perthes disease is to prevent or minimize the development of deformities of the hip. Patients who are >8 years of age with type C lateral Pillar classification are expected to have poor outcome. With increasing age, the time available for the remodeling phase is limited, which may lead to rapid joint deterioration. A retrospective review was performed for 44 children (48 hips) with Catterall grade 2, 3, or 4 Legg-Calvé-Perthes disease with onset over 8 years or older followed to maturity. Patients were divided into 4 groups (a no-treatment group and 3 interventional groups). Patients were in the sclerosis or early fragmentation phase at the time of the operation. Overall for all treatment modalities, only 19% had a satisfactory Stulberg grade II outcome. Therefore, whatever the treatment, the outcome is poorer with increasing age.

Combined innominate and femoral osteotomies are generally performed to better contain and to provide more coverage of the femoral head by the acetabulum. Radiographic outcome of 20 patients with a disease onset of over 8 years who had undergone combined femoral and Salter innominate osteotomies was recorded. The classification of the hips was 11 lateral pillar group B, 7 group B/C, and 2 group C. The patients were evaluated with a mean follow-up of 5 years and 5 months using the Stulberg radiographic classification. Among these 20 hips, 6 became Stulberg II (33%), and 9 were IV. The main complication among this group was joint stiffness in 1 case that was treated by adductor tenotomy and joint release.

The first description of arthrodiastasis was given by Aldegheri in 1981. The aim of joint distraction is to neutralize muscle and weight-bearing forces, to prevent stress fractures of subchondral bone, and to promote creeping substitution. Experimental studies revealed the importance of continuous passive motion or intermittent active motion in the repair of articular cartilage defects. Hence, articulated distraction could improve healing of articular cartilage in the rabbit animal model. Soft tissue release in some or all the cases was performed during fixator application. We have been practicing articulated distraction in our center since 1992; however, the development of pain during passive or active hip motion leads to the refusal of most patients to mobilize the hip. Besides, we believe that the theoretical advantage of soft tissue release and joint motion during distraction has not been proven clinically. This theory was based on experimental studies regarding cartilage defects and not Legg-Calvé-Perthes disease. Hence, since 1995 we treated patients with nonarticulated distraction and without soft tissue release.

Maxwell et al in 2004 studied the impact of arthrodiastasis on the preservation of the femoral head in boys over the age of 8 years and girls over 7 years at the time of onset of symptoms of Legg-Calvé-Perthes disease. The patients were in the early fragmentation stage with minimal femoral head collapse (type A or B Herring Lateral Pillar classification at the time of the operation). After an average follow-up of 38.4 months, all the hips maintained their epiphyseal height except 2 (of the 15 operated cases). However, the follow-up was short and the sample included cases with minimal involvement, which may have the same results with other modalities of treatment.

Kucukkaya et al in 2000 reported 11 children with avascular necrosis of the femoral head (Legg-Calvé-Perthes disease in 8 of them) treated with articulated distraction. The patients with Legg-Calvé-Perthes disease were 3 and 4 Catterall classification, and B and C Lateral Pillar classification and all of them had >1 Catterall head at risk factors. Final follow-up results according to Stulberg were: spherical congruency 4 cases, aspherical congruency 3 cases, and 1 case of aspherical incongruency. They recommended this type of treatment for children older than 6 years who have Catterall risk factors, and poor results are expected from other treatment modalities.
Other investigators considered this type of treatment for children older than 9 years with severe form of the disease, with persistent severe pain, and with limited range of hip motion, which qualified them for salvage procedures. They reported good short-term clinical and radiologic results.

In our series, we had 9 cases with spherical congruency (Fig. 3), 11 cases with aspherical congruency, and 1 case with aspherical incongruency (of the 21 cases who reached skeletal maturity at last follow-up). Kucukkaya et al in 2000 had comparable results with the use of articulated distraction. The joint distraction without mobilization may carry the risk of hip joint stiffness. However, there was marked improvement of the range of motion from an average of 40 (range, 0 to 65 degrees) to 80 degrees (range, 0 to 120 degrees) at last follow-up. Other investigators reported improvement of flexion by a mean of 20 degrees after soft tissue release and articulated distraction.

The rate of pin track infection was high (76%), with more prevalence in the acetabular side. This may carry the risk of potential infection if hip arthroplasty would be required in the future. Another unusual complication occurred in a 14-year-old boy with completely stiff hip preoperatively and mushroom-shaped head. Physeal distraction instead of joint distraction occurred in this case. To the best of our knowledge, there were no reports of physeal distraction of the upper femoral epiphysis before. We could not identify the reason behind this unusual phenomenon. Perhaps, the tension was conveyed to the femoral epiphysis instead of the hip joint due to marked intra-articular adhesions.

The technique of physeal distraction included the application of the half pins or k-wires to the epiphysis and to the diaphysis perpendicular to the axis of bone and gradual distraction by an external fixator. We did not apply any sort of fixation to the epiphysis of the femoral head. It seems that the tension was accumulating over time till sudden epiphyseal fracture or chondrodiastasis occurred. Slow, controlled, and symmetrical distraction of the epiphyseal plate without fracture or rupture signifies chondrodiastasis. In our case, there was no complaint of intense pain during distraction. Plain x-rays revealed 1.6 cm physeal distraction and lengthening of the femoral neck. At last follow-up after 8 years, there was no pain, no leg length inequality, but stiff hip was observed.

The limitations of this study were that there was no control group as it was difficult to leave these patients with severe forms of the disease without treatment. Only
Complications (1) Pin track infection in most of the cases (2) Fracture pin in 2 cases (3) Stiffness of the hip in 2 cases
Stage at operation Fragmentation Sclerosis or Fragmentation
Stulberg classification — —
Age (y) 7.1-12.5 5-8 6-10 9.4-15.1 8-14
Lateral pillar classification Articulated Articulated + soft tissue release Articulated Articulated + soft tissue release
Type of distraction Articulated Articulated + soft tissue release Articulated Articulated + soft tissue release

21 cases (72%) reached skeletal maturity at last follow-up. Besides, very few centers recommend arthrodiastasis.23 Comparing the results with other series was difficult due to the use of different classification systems and outcome measures (Table 1).4,19,24,25 The form of adductor tenotomy or illeopsoas release may be added to the. Arthrodiastasis can be articulated or nonarticulated. Soft tissue release in the form of adductor tenotomy or illeopsoas release may be added to the procedure. Articulated hip distraction with soft tissue release has few theoretical advantages over nonarticulated distraction, which has not been proven clinically.

Arthrodiastasis has been used in the early stages of Legg-Calvé-Perthes disease (sclerotic or fragmentation phase) whatever the age of the patient. It has been applied as a definitive treatment or as a first step before surgical containment.26 It can also be applied as a salvage procedure in patients older than 8 years with severe types of Legg-Calvé-Perthes disease and with marked restriction of hip movement.

In late-onset severe cases, preliminary arthrodiastasis may reduce the pain and improve the range of motion before proceeding to surgical containment as varus osteotomy of the femur.

In conclusion, nonarticulated joint distraction without soft tissue release seems to yield similar results to articulated hip distraction in older patients with severe forms of Legg-Calvé-Perthes disease.

REFERENCES