late-onset Perthes disease usually carries a poor prognosis. In severe cases there may be increasing pain, decreased range of motion and hinge abduction which forms a contraindication for surgical containment. We have managed 14 such patients in a two-stage procedure. Arthrodiastasis done as a first stage dramatically reduced pain and Trendelenburg limp while at the same time leading to a substantial improvement in range of motion and hinged abduction. Once the contraindications to surgical containment were overcome by arthrodiastasis, we proceeded with a varus osteotomy of the femur in a second stage in the hope that the femoral head would remodel to some extent with time and would improve the final functional outcome.

Keywords: arthrodiastasis; articulated hip distraction; hinged abduction; late-onset Perthes disease; varus osteotomy femur.

INTRODUCTION

Perthes disease has been studied extensively for almost the last 100 years. Yet the aetiology is still not clear and the outcome is unpredictable. It predominately affects young boys around 4-8 years of age (4). Late-onset after the age of 9 usually carries a poor prognosis (11). Due to the short time left until skeletal maturity, the remodeling phase is inadequate to accommodate the deformed head into the acetabulum. Especially in severe cases of late-onset Perthes disease, flattening of the femoral head with joint incongruity can lead to “hinged abduction” and premature osteoarthritis of the hip (10,16).

In Perthes disease, containment of the head in the acetabulum and an acceptable range of motion are the aims of management in the belief that the femoral head is biologically plastic. However, there is still no consensus as to when to perform a surgical containment (8). It is at present generally accepted that, if less than half the head is necrotic and the lateral pillar is intact, no treatment is necessary, as it would not alter the natural course of the condition. If more than half of the head is necrotic and the lateral pillar is collapsed, some attempt to improve the natural course of the disease appears warranted.

Both surgeries, on the femoral or pelvic sides, have their advocates. The rationale is to reduce the laterally subluxated portion of the femoral head to better distribute joint forces. If the femoral head is in the acetabulum and there is a good range of...
motion, results should be good provided there is sufficient growth remaining to allow some remodeling. Girls are said to have a worse prognosis; this could be related to their earlier skeletal maturity with less time remaining for remodeling (4).

In our clinical setup many patients present to us in a later stage of the disease when there is already hinge abduction or poor range of motion. Containment procedures are contraindicated in these patients, which in turn makes the outcome of the disease even worse. We have treated these patients in a two-stage procedure. Stage one involves arthrodiastasis or articulated joint distraction using an external fixator in all patients. The goal of arthrodiastasis is to prevent further femoral head flattening while improving the mobility of the involved hip. Once the range of motion of the hip joint improves and the joint distracts sufficiently for the head to be able to relocate into the acetabulum, containment of the head by a varus osteotomy of the femur is performed as a second stage procedure.

In this study we present our experience in 14 patients with symptomatic late-onset Perthes disease who have undergone arthrodiastasis and containment as a two-stage procedure.

MATERIALS AND METHODS

The study was carried out over a period of 5 years (from July 2003 to September 2008) in all patients presenting to us with severe late-onset Perthes disease. Clinical assessment included hip range of motion (ROM), limp and Trendelenburg sign and a subjective pain scale (table I). Radiological assessment included classification categorization according to Catterall (4) and Herring (9) and the “at risk” signs (table II).

Inclusion criteria included:
1. Age > 9 years with pain
2. Either hinge abduction or a global restriction of hip range of motion with abduction less than 30 degrees.
3. Hip subluxation with > 50% hip involvement

Over a period of 5 years, 134 patients presented in our institution with Perthes disease. Of these 34 were found to be greater than 9 years old. Based on clinical and radiological assessment, 14 patients were included in our study.

There were 11 males and 3 females. The average age at surgery was 11 years and 3 months (range 9 years and 2 months to 14 years). The patients were symptomatic for an average of 16 months (range 8 months to 36 months) before surgery. Six patients had hinge abduction while 8 had a global restriction of the range of motion of the hip; hence they were not considered as candidates for primary containment surgery.

All the hips were graded Catterall IV and Herring C. There were 11 hips with four and 3 hips with three Catterall “head at risk” signs. Radiological assessment also included calculation of the Reimer’s extrusion index (17). This is defined as the percentage of the femoral head at the widest transverse diameter that protrudes laterally to Perkin’s vertical line. Varying degrees of lateral extrusion were seen in our patients (fig 1). The mean preoperative Reimer’s index was found to be around 20% (table III). The average follow-up was 38 months (range 12 to 59 months).

As part of the first stage of management, all patients underwent an articulated distraction of the hip joint using an external fixator (fig 2). Four of the patients required an adductor tenotomy. Arthrodiastasis was started at a rate of around 0.5 mm per day. Distraction was continued till sufficient space became visible radiologically for the head to relocate and contain in the acetabulum as seen on radiographs taken in maximum possible abduction.

The fixator was kept on for 4 weeks, after which the hip joint was mobilized in bed with upper tibial pin
traction. Aggressive range of motion exercises were continued to regain as much joint range of motion as possible.

Post arthrodiastasis, detailed records of range of motion, pain complaints and Trendelenburg sign were kept. In a second stage all patients underwent containment surgery, once the pin tracts were healed. We performed a femoral varus osteotomy (fig 3) to contain the head after articulated distraction had overcome the hinge abduction and improved the range of motion. Full weight bearing was allowed only after radiological evidence of union at the osteotomy site. However, range of motion exercises were encouraged in all patients. At follow-up, evaluation included range of motion, subjective pain estimation and radiological assessment. All statistical analysis was done using Wilcoxon-signed rank test (non-parametric test).

RESULTS

Before arthrodiastasis, 4 patients had severe pain, 7 had moderate pain and 3 had mild pain as documented by the subjective pain scale. Post arthrodiastasis, only one patient still had moderate pain, suggesting a statistically significant reduction in pain after surgery (table III). All patients had an improved ROM of the hip (fig 4) and this improvement was statistically significant (table III). Flexion improved by an average of 28°, abduction by 22° and internal rotation by 20°. The Trendelenburg sign disappeared in 8 patients while it persisted in 6. Hinge abduction noted in 6 patients preoperatively was eliminated in all.

Pin related complications occurred in 3 patients. In two of these, the pins became loose, while there was breakage of a pin in one. The pins were changed in all three patients. Special pin tract care using ciprofloxacin eye drop solution three times a day was ensured in all patients and no case of pin tract infection was reported.

All pin tracts healed uneventfully and a second stage femoral varus osteotomy resulted in good containment in all patients. Preoperative and postoperative containment as measured by Reimer’s subluxation index showed an improved coverage and this result was found to be statistically significant (table III).

Consolidation of the osteotomy site was noted at an average of 3 to 4 months (fig 5) and full weight bearing allowed only after that.

Table III. — Comparison of pre and post operative clinical and radiological variables

<table>
<thead>
<tr>
<th></th>
<th>Preoperatively</th>
<th>Postoperatively</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Pain Score</td>
<td>2.07 ± 0.73</td>
<td>0.14 ± 0.53</td>
<td>0.001*</td>
</tr>
<tr>
<td>Mean Flexion arc</td>
<td>60.50 ± 6.93</td>
<td>88.21 ± 10.67</td>
<td>0.001*</td>
</tr>
<tr>
<td>Mean Abduction arc</td>
<td>10.53 ± 6.03</td>
<td>31.78 ± 5.75</td>
<td>0.001*</td>
</tr>
<tr>
<td>Mean Rotation arc</td>
<td>17.14 ± 7.52</td>
<td>37.5 ± 7.53</td>
<td>0.001*</td>
</tr>
<tr>
<td>Mean Reimer’s extrusion index (%)</td>
<td>20.14 ± 3.13</td>
<td>9.07 ± 2.30</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

* Significant.
skeletal maturity, and (2) the severity of the disease with involvement of 50% or more of the femoral head or collapse of the lateral pillar, and lateral subluxation with hinge abduction (15,20,21).

Surgical containment can still be beneficial in such patients despite the limited time for remodeling due to older age. However a stiff hip or hinge abduction can be a contraindication for surgical containment, thus diminishing the treatment options further. Our results with arthrodiastasis in such patients show improvement in pain and increased ROM of the hip along with elimination of the hinge abduction, which allowed us to proceed with a surgical containment later on.

Arthrodiastasis reduces the mechanical stress across the hip joint, which may facilitate cartilage proliferation and endochondral ossification of the proximal femoral epiphysis (18,19). Joseph et al (11) have recommended that treatment should be started

**DISCUSSION**

Treatment of Perthes disease has always been controversial. Most orthopaedic surgeons agree that not all patients need operative treatment nor on the other hand can be treated conservatively or left alone. late-onset Perthes disease poses a special challenge. Prognosis is usually poor because of (1) the short time available for remodeling before
before epiphyseal collapse had occurred, since the potential to remodel in the older age group is limited. Some authors (12) have applied the articulated distractor to hips with minimal collapse in order to maintain epiphyseal height. They reported early results with preservation of epiphyseal height and arrest of epiphyseal collapse. However we used arthrodiastasis in patients with Herring grade C and Catterall grade IV where already substantial epiphyseal collapse had occurred. Our aim was only to improve the range of motion or eliminate the hinge abduction that prevented surgical containment.

Various authors (1,3,7) have documented the efficacy of articulated hip joint distraction to overcome stiffness and pain in the hips secondary to various aetiologies like Perthes, epiphysiolysis, congenital dysplasia, tuberculosis and idiopathic chondrolysis, and the results have been good. We also based our study on this concept and found excellent results of arthrodiastasis in severe late-onset Perthes disease. Segev et al (14) have treated severe late-onset Perthes using soft tissue release and arthrodiastasis in 16 patients. We performed adductor tenotomies in only 4 patients. We also went a step further by doing a containment varus osteotomy once the range of motion improved. The long-term results of such surgical containment procedure can however only be evaluated at skeletal maturity.

Complications related to arthrodiastasis include pin tract infections, pin loosening and pin breakage. However a dedicated pin tract care with slow distraction can help prevent these complications. We had only one case of pin breakage occurring in an obese patient in whom the initial distraction was carried out at a faster rate as compared to the rest of our patients.

Several authors (2,22) have recommended a valgus extension osteotomy as a salvage procedure for hinge abduction. Based on the results of our patients, we however feel that arthrodiastasis is a minimally invasive yet an effective procedure for hinge abduction in severe Perthes disease. Some authors (6) have also recommended cheilectomy to improve the range of motion. But we strongly believe that cheilectomy has the serious disadvantage of reducing the load bearing area of the joint and increasing the stress forced across the hip. Rowe et al (13) have also shown that cheilectomy is not effective at preventing the early appearance of osteoarthritic changes in hips with a deformed head and hinge abduction.

To conclude, arthrodiastasis appeared in this study as a minimally invasive procedure that improved range of motion and eliminated hinge abduction in
cases of severe late-onset Perthes disease. It lead to symptomatic improvement in patients due to pain relief and improvement in gait. It did not compromise future surgery and opened the way to surgical containment in patients in whom such a surgery was contraindicated due to stiffness or hinge abduction. A contained hip, even if incongruent, will have greater chances to a better outcome than a subluxated hip.

REFERENCES


