Long-Term Results of Derotational Femoral Varus Osteotomy in Legg-Calvé-Perthes Disease: 26-Year Follow-Up  

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Abstract  

The long-term results of 30 patients (31 hips) who underwent derotational femoral varus osteotomy for Legg-Calvé-Perthes disease are presented. Pain, leg-length discrepancy, Trendelenburg sign, and range of motion at the operated hip were examined clinically. Radiographic analysis included measurement of the Wiberg angle, epiphyseal index, acetabular index, and the Mose index. All were found to be satisfactory for patients in the good/fair category. Good/fair results were obtained in 27 (87%) of 31 hips according to Catterall’s postoperative classification. Four patients were classified in the poor category due to severe restriction of movement and constant hip pain. Therefore, derotational femoral varus osteotomy is recommended for the treatment of patients with Legg-Calvé-Perthes disease.  

In the treatment of Legg-Calvé-Perthes disease, the objective is to minimize the development of hip deformities. Therefore, it is important to contain the femoral head within the acetabulum. Several treatment methods are available.  

Since Aker and colleagues reviewed femoral varus osteotomy as a treatment for Legg-Calvé-Perthes disease, this method has become popular, although not unanimous. Over the past few decades, several institutions have used femoral varus osteotomy as a treatment modality for Legg-Calvé-Perthes disease. This technique has advantages and possible drawbacks. Among the advantages, it can increase femoral head coverage within the acetabulum, decrease forces acting on the weight-bearing femoral head, and prevent slipping of the epiphysis on the metaphysis by correcting the position of the epiphyseal line. The disadvantages are the possible persistence of varus angulation, nonunion of osteotomy, trochanteric prominence, and leg-length discrepancy. Abductor lurch, development of Trendelenburg gait, early closure of the physis, and a secondary operation for fixator removal are disadvantages.  

Many modalities of treatment have been used for the treatment of Legg-Calvé-Perthes disease; however, the success of different treatment types and the justification of principles involved can only be analyzed on a long-term basis. The number of such publications reporting long-term results of surgical management for Legg-Calvé-Perthes disease is small. Moreover, these publications regularly deal with long-term results achieved with various modes of treatment. Some of the publications are listed in Table 1.  

Our department has been extensively involved in the surgical treatment of Legg-Calvé-Perthes disease using derotational femoral varus osteotomy. This article presents the long-term results of a retrospective study of patients who underwent femoral varus osteotomy with femoral derotation between 1970 and 1980. This study clinically and radiographically assessed the long-term results of femoral varus osteotomy and femoral derotation in patients who had attained skeletal maturity and derived valid conclusions. These results were not compared to outcomes obtained with other modes of surgical containment.  

Materials and Methods  

Between 1970 and 1980, 93 patients underwent derotational femoral varus osteotomy at the Department of Orthopedics, Medical Faculty, University of Pécs. Before undergoing surgery, patients had to meet several criteria: 1) range of motion could not be restored
by conservative measures, 2) ≥50% of the femoral head was diseased, and 3) Catterall\textsuperscript{a} classification to groups 3 and 4.

Thirty-one hips in 30 patients (19 men and 11 women) were available for follow-up examination an average 26 years postoperatively. Of the 31 hips, 12 were left and 19 were right hips. Mean patient age at surgery was 6 years (range: 3-11 years), and mean follow-up was 26 years (range: 19-32 years). During the follow-up examination, patients filled out questionnaires, underwent physical examination, and had radiographs obtained of the operated and nonoperated hips.

Clinical assessments of all patients were made by two observers (V.H. and S.S.) for reproducibility. All patients were evaluated for pain, Trendelenburg sign, leg-length discrepancy, thigh atrophy, and range of motion of the operated hip.

Recent radiographs were obtained and assessed for acetabular index, epiphysial index, Mose index, and Wiberg angle (Table 2). The evaluation of the different radiographic parameters was performed by three observers for reproducibility.

### RESULTS

The Catterall postoperative classification was used to evaluate the results (Table 3). Group 1 was composed of 7 (22%) hips classified as good (Figure 1). Group 2 was composed of 20 (65%) hips classified as fair (Figure 2). Group 3 was composed of 4 (13%) hips classified as poor (Figure 3). For better comparative understanding of the results, the good and fair hips were grouped together and compared to the poor hips.

Five (17%) patients experienced pain during exercise whereas 3 (10%) patients experienced pain at rest. Four (13%) patients had inguinal pain when pressure was applied in the region. Eighteen (60%) patients experienced no pain.

On leg-length discrepancy examination, 6 (20%) patients had an increase in length whereas 6 (20%) patients had a decrease in leg-length on the operated side. The remaining 18 (60%) patients did not demonstrate leg-length discrepancy. The discrepancy was always <3 cm. Trendelenburg sign was positive in 5 (17%) patients, and atrophy of the thigh on the operated side was present in 6 (20%) of 30 patients. Average range of motion for the total population examined was: extension 9°, flexion 119°, internal rotation 21°, external rotation 38°, abduction 45°, and adduction 27°.

The overall average Wiberg angle was 27°, epiphysial index was 53%, acetabular index was 49%, and the Mose index was calculated to be ≥0-2 in 72% of patients. In the good/fair group, the Wiberg angle was 32.2° for men and 29.2° for women, epiphysial index was 54%, acetabular index was 51, and Mose index showed an average femoral head arch deterioration ≤2 mm (acceptable) on average. Conversely, the poor group values were Wiberg angle of 19.7° in men and 21° in women, epiphysial index 48%, acetabular index 45%, and Mose index was always poor (deterioration of ≥2 mm) (Table 4).

### DISCUSSION

Deformity of the healed femoral head is the major factor predisposing to the development of osteoarthritis after Leeg-Calvé-Perthes disease. Therefore, it is important to use a treatment modality that provides maximum containment to the femoral head and allows best possible recovery to the femoral head and minimizes deformities.\textsuperscript{1,2,9} Derotational femoral varus osteotomy is one method of providing such containment.

Thirty patients (31 hips) were available for our follow-up study. The number of patients is much smaller than other publications.\textsuperscript{1,2,4,6,16} However, this follow-up examination is significant because of the time elapsed since surgery (mean 26-year follow-up). Also, because all patients have reached skeletal maturity, the results enable us to view the treatment of Legg-Calvé-Perthes disease with derotational varus osteotomy in a better perspective and draw valid conclusions.

Generally speaking, favorable clinical and radiographic results were obtained in most patients. This is in contention with several other studies.\textsuperscript{8,16,19} Range of motion was painless and the radiographic results of the affected hips were according to our expectations, a conclusion also shared by Coates et al.\textsuperscript{20}

Using the Catterall postoperative classification, 27 (87%) of 31 hips were classified as good or fair with patients coping well in terms of employment and efficiency; and most of the women also had children. In this subpopulation (good/fair group), no pain was experienced on weight bearing or exercise; occasional pain was attributed to other reasons. Leg-length discrepancy was
TABLE 2
Radiographic Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Normal Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiberg Angle</td>
<td>Helps identify coverage of the femoral head and its relation to the acetabulum</td>
<td>34° for males (range: 20°-50°); 35° for females (range: 25°-48°)</td>
</tr>
<tr>
<td>(Center Edge Angle)</td>
<td></td>
<td>Children aged &lt;7 years is 55 to 45; individuals aged ≥7 years is 45 to 35. Decreasing index value with age is considered a sign of joint deterioration.</td>
</tr>
<tr>
<td>Epiphyseal Index</td>
<td>Percentage of the height of the epiphysis against the width of the epiphysis. The epiphyseal index was further improved and converted into an epiphyseal quotient that incorporated both the affected and normal side, expressed as a percentage.</td>
<td>Varies from 41.6 at birth to 60 or 70 in an adult.</td>
</tr>
<tr>
<td>Acetabular Index</td>
<td>Ratio of the depth of the acetabulum against the width of the aperture of acetabulum.</td>
<td></td>
</tr>
<tr>
<td>Mose Index</td>
<td>Evaluated on anteroposterior views. If the whole line of the epiphysis follows one arch of the concentric circles on a transparent sheet, the result is graded as excellent; if the arch deterioration is between 0 and 2 mm, it is acceptable; and if the lines of congruency deteriorate by &gt;2 mm it is graded fair.</td>
<td></td>
</tr>
<tr>
<td>(Sphericity Index)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 3
Catterall9 Postoperative Classification

<table>
<thead>
<tr>
<th>Group</th>
<th>Characteristics</th>
<th>No. Hips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Hip causes no symptoms and has full range of motion. Radiographically, the head is round and well contained within the acetabulum. Some loss of epiphyseal height is accepted provided the head is round.</td>
<td>7</td>
</tr>
<tr>
<td>Fair</td>
<td>Hip causes no symptoms but movements are slightly restricted, especially internal rotation. The head is round but broadened and not fully contained within the acetabulum, up to one fifth being uncovered. Loss of epiphyseal height is always present.</td>
<td>20</td>
</tr>
<tr>
<td>Poor</td>
<td>Hip may not be completely free from symptoms and always shows restriction of movement.</td>
<td>4</td>
</tr>
</tbody>
</table>

TABLE 4
Results of Radiographic Parameters Examined According to Groups

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Group</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiberg angle (°)</td>
<td>Men</td>
<td>32.2</td>
<td>19.7</td>
<td></td>
</tr>
<tr>
<td>Epiphyseal Index</td>
<td>Women</td>
<td>29.2</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Acetabular Index</td>
<td></td>
<td>0.51</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>Mose Index (mm)</td>
<td></td>
<td>&lt;2</td>
<td>&gt;2</td>
<td></td>
</tr>
</tbody>
</table>

relatively minor and did not affect the results significantly. In 4 (13%) patients who were classified as poor, the hip was painful and significantly restricted in motion, and radiographs showed the characteristic “mushroom head.” These heads indicate the initiation or advancement of premature osteoarthritis. In such cases, further surgery is hard to avoid.

The literature states that poor results should be anticipated in women and those patients undergoing surgery at a late age.21-23 However, in our study the men and women presented in equal numbers (1:1) in the poor category and their age at surgery was 5-11 years. Fewer patients had a positive Trendelenburg sign in our study compared to Coates et al.20 Three of five patients demonstrating positive Trendelenburg sign were in the poor group. Similarly, all four patients in the poor group demonstrated thigh atrophy. During the course of clinical examinations, subjective opinions were gathered from the patients about their conditions. Twelve of 20 patients originally grouped in the fair category did not consider the slight reduction in range of motion a handicap. Conversely, all 4 patients in the poor category were severely distressed with pain and restricted range of motion.

Because no consensus exists on the optimum system for the evaluation of Legg-Calvé-Perthes disease, some authors have used the Stulberg classification, whereas others have used the Catterall classification. Also, the indications and age at surgery vary according to the clinical picture. Therefore, due to these factors it is difficult to immediately compare the results of our study to those using other evaluation methods. However, our criteria were approved by this study. We believe this surgery should be performed in a carefully selected pool of patients in whom 1) range of motion can not be restored by conservative measures, 2) ≥50% of the femoral head is involved, and 3) classi-
sification is Catterall stages 3 and 4. Assessment of the collodyaphyseal angle during preoperative planning is important in committing better containment.24

In accordance with Belleye and Mike,25 we believe femoral varus osteotomy provides a good prognosis in the treatment of Legg-Calvé-Perthes disease and improves the natural history of the disease. By following the above outlined criteria in selected patients with Legg-Calvé-Perthes disease, good containment and remodeling of the femoral head as well as improved range of motion, pain control, and a better sense of well being can be achieved.

REFERENCES


