

# SPITZY SHELF ACETABULOPLASTY FOR PERTHES DISEASE

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## Abstract

**Background:** *The study aimed to evaluate the clinical and radiological outcomes of Spitzzy shelf acetabuloplasty in Legg–Calvé–Perthes disease (LCPD) excluding cases with hinge abduction.*

**Methods:** *This prospective case series study was conducted in the period from January 2018 to May 2020 at Cairo University Children’s Hospital (Abou El Reesh). A total of 20 cases were done. 16 were males and four were females. The mean age at onset of disease was 8.5 years (range: 8 years to 10 years). Pre-operatively, four patients were on the initial stage and 16 patients were on the fragmentation stage (six cases classified as lateral pillar group B and ten cases classified as group B/C). Patients were followed up for a mean of 18.3 months (range: 12 to 26 months). Clinical assessment was done using modified Sundt criteria. Radiological parameters were followed up. Stulberg classification was done for cases that reached the healed stage on follow up.*

**Results:** *Clinically, 17 cases were good and three cases were fair according to modified Sundt criteria. Radiologically, all the parameters improved significantly. Nine cases reached the healed stage on follow up. Three cases were classified as Stulberg II, five cases as Stulberg III and one case as Stulberg IV.*

**Conclusion:** *We recommend Spitzzy shelf acetabuloplasty for the management of early stages of LCPD in patients with onset of the disease over eight years. This protocol of management yields a favorable clinical and radiological results with 88.9% of cases achieving Stulberg III or less outcome.*

**Key words:** *Legg–Calvé–Perthes disease, Spitzzy shelf acetabuloplasty, Stulberg classification*

## INTRODUCTION

Legg-Calvé-Perthes disease (LCPD) is a condition in which there is disruption of the blood supply to the capital femoral epiphysis, resulting in osteonecrosis and cessation of growth of the ossific nucleus. The etiology is probably multifactorial. LCPD passes through different stages and it results in morphological and developmental changes affecting proximal femur and acetabulum. During the resorptive phase, the mechanical properties of the femoral head are weakened and femoral heads are prone to collapse. With progression of the disease, femoral head gradually reossifies and remodels to a various degree of sphericity until skeletal maturity <sup>1</sup>.

Most current treatment approaches depend on containing the femoral head within the acetabulum. Various methods have been used including bracing, Petrie cast, femoral osteotomies

and pelvic osteotomies. It is believed that containment treatment, if applied early in the course of the disease, will prevent advanced deformation of the femoral head and this in turn will decrease the risk of development of degenerative joint disease later on <sup>1</sup>.

Shelf acetabuloplasty augments the lateral edge of acetabulum and increase the coverage of femoral head. Although some authors advocate its use as a salvage procedure in late LCPD <sup>2</sup>, others support its use for containment of extruded hips in earlier stages of the disease <sup>3,4</sup>. The shelf acetabuloplasty is assumed to stabilize acetabular labrum and it has been proved to have a stimulatory effect on acetabular growth <sup>5</sup>. The aim of this study was to evaluate the clinical and radiological outcomes of Spitzzy shelf acetabuloplasty as containment treatment in early stages of Legg–Calvé–Perthes disease excluding cases with hinge abduction.

## **PATIENTS AND METHODS**

This case series study was conducted in the period from January 2018 to May 2020. A total of 20 cases were done. 16 of the patients were males (80%) and four were females (20%). All the cases were done at Cairo University Children’s Hospital (Abou El Reesh). The disease affected the right hip in 15 cases (75%) and the left hip in five cases (25%). No bilateral cases were included in this series.

The mean age at onset of disease was 8.5 years (range: 8-10 years). Regarding pre-operative classification, four patients (20%) were on the initial stage, therefore cannot be classified according to the lateral pillar classification system and 16 patients (80%) were on the fragmentation stage (six cases classified as lateral pillar group B and ten cases classified as group B/C). Patients were followed up for a mean of 18.3 months (range: 12 to 26 months).

Patients included in this study were those with active LCPD in fragmentation stage with onset of disease above the age of eight years and classified as Herring lateral pillar group B or B/C and patients with active LCPD in initial stage with onset of disease above the age of eight years if they develop loss of abduction or lateral extrusion of capital femoral epiphysis.

Exclusion criteria were active LCPD with onset of disease below the age of eight years, active LCPD classified as Herring lateral pillar group A or C, cases with hinge abduction, and cases with healing or healed LCPD.

### **Protocol**

All the patients were subjected to a formal clinical assessment which included: history taking, onset of complaint, analysis of pain, type of limp if found, clinical examination to assess range of movement, presence of flexion deformities, any tender points and shortening if present.

Radiographic assessment of all cases was done by taking pre-operative pelvis AP and frog lateral X-ray views to assess for Waldenstrom stages and Herring lateral pillar classification.

Routine pre-operative laboratory investigations included complete blood count, coagulation profile and liver and kidney function tests.

### **Operative technique**

Surgery was done in supine position on a radiolucent operating table with towels under the operated hip to elevate it. Anesthesia regimen was in the form of general anesthesia and caudal analgesia. The technique of shelf acetabuloplasty was modified from that described by Spitzky<sup>6</sup>. A bikini incision was made below the iliac crest passing 1.5 cm below anterior superior iliac spine (ASIS).

The iliac apophysis was splitted and Smith-Peterson interval between tensor fascia lata and sartorius was developed. Iliopsoas muscle tenotomy was done at the level of pelvic brim to reduce the pressure on the femoral head. The outer surface of the iliac bone was exposed subperiosteally down to the lateral joint capsule. The reflected head of the rectus femoris tendon was identified and divided to expose the underlying joint capsule. A broad osteotome was used to make a slot for the shelf in the iliac bone (approximately 3-4 cm in width), just proximal to the acetabular labrum and in a medial and slightly proximal direction. Subsequently, a trapezoidal bone graft was obtained from the iliac crest. The bone graft (approximately 4 cm base and 4 cm length) was impacted into the slot with the slightly concave cortical side downwards. The graft was placed directly over the joint capsule covering the femoral head. No internal fixation of the graft was used. The reflected rectus femoris tendon was sutured back over the shelf in eight patients. Closure in layers was done (Fig. 1).

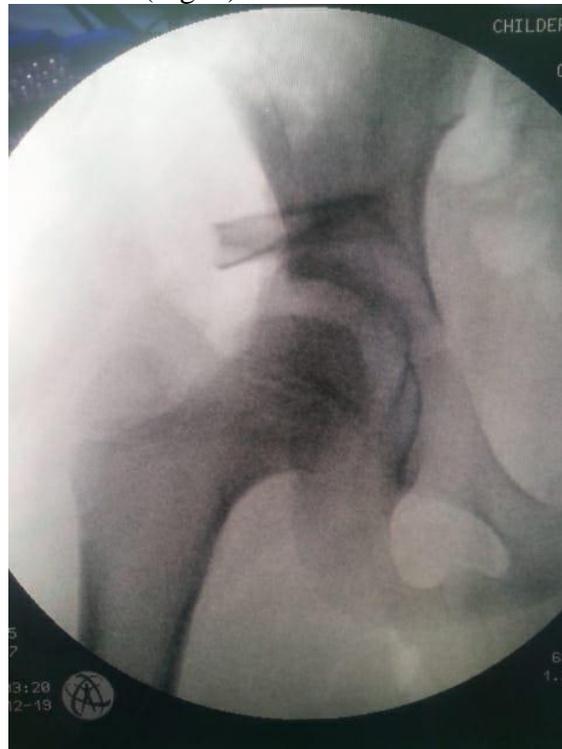


Figure 1: Intraoperative fluoroscopy image.

### **Post-operative regimen**

Spica casting was done for four weeks. Non weight bearing for six weeks followed by progressive weight bearing as tolerated.

Patients were followed up at regular intervals to assess for clinical and radiographic parameters according to the following schedule:

- 1st week: check cast and neurovascular function.
- 4<sup>th</sup> week: Removal of cast, check for wound or skin complications, confirm neurovascular function and follow up X-ray.
- 6<sup>th</sup> week: Start weight bearing as tolerated and check for return of range of movement.
- 8<sup>th</sup> week: Clinical examination and follow up X-ray.
- 3 months: Clinical examination and follow up X-ray.
- 6 months: Clinical examination and follow up X-ray.
- 12 months: Clinical examination and follow up X-ray.
- 18 months: Clinical examination and follow up X-ray.
- Yearly follow up clinically and radiologically until skeletal maturity.

### **Clinical assessment**

Functional outcomes were determined using modified Sundt criteria <sup>7</sup>:

- Good: no pain and full range of movement.
- Fair: restricted range and/or occasional pain.
- Poor: pain and hip motion markedly restricted.

### **Radiographic assessment**

The following parameters were followed:

- Center edge angle of Wiberg (CEA).
- Sharp's acetabular angle.
- Stulberg classification for patients who reached healed stage of the disease.

## **RESULTS**

### **Clinical outcomes**

At the final follow up, 17 cases (85%) were considered good according to modified Sundt criteria <sup>7</sup> with no pain and full range of movement. Three cases (15%) were considered fair because of occasional pain and no cases were considered as poor result.

Two cases were complicated with mild superficial wound infection which improved with conservative treatment (IV cefoperazone and daily dressings for one week). Two other cases had transient lateral femoral cutaneous nerve neurapraxia which improved after approximately 3 months.

Although the mean age at diagnosis for patients with fair result was 106 months and the mean age for patients with good result was 101.2 months, this difference was not statistically significant ( $P = 0.304$ ). Also, the four cases who were on the initial stage of the disease at time of surgery had good result clinically. But this relation was not statistically significant ( $P = 1$ ).

Pre-operative classification of cases remained the same during follow up except in five cases. Four cases were on the initial stage pre-operatively progressed to fragmentation stage (Herring lateral pillar group B) and one case classified pre-operatively as Herring lateral pillar group B/C progressed to lateral pillar group C on follow up (Table. 1).

Table 1: Relation between pre-operative classification of the disease and clinical outcome.

		Stage						P value
		B		B/C		initial		
		Count	%	Count	%	Count	%	
<b>Modified Sundt</b>	<b>fair</b>	1	16.7%	2	20.0%	0	0.0%	1
	<b>good</b>	5	83.3%	8	80.0%	4	100.0%	

**Radiological outcomes**

CEA increased from a mean of 26.96 to 32.37 degrees ( $P < 0.001$ ). Sharp’s acetabular angle decreased from a mean of 40.76 to 37.52 degrees ( $P < 0.001$ ).

**Stulberg grading**

At the final follow up, nine cases reached the healed stage of the disease. They were classified according to Stulberg classification. Three cases (33.3%) were classified as Stulberg II, five cases (55.6%) were classified as Stulberg III and one case (11.1%) was classified as Stulberg IV. No cases were classified as Stulberg I or V (Fig.3).

Considering Stulberg I, II and III as good outcome and Stulberg IV as bad outcome, the mean age at diagnosis for the good outcome group was 101.8 months, while that of the bad outcome group was 108 months. Although the mean age at diagnosis increased, this difference was not found to be statistically significant ( $P = 0.110$ ).

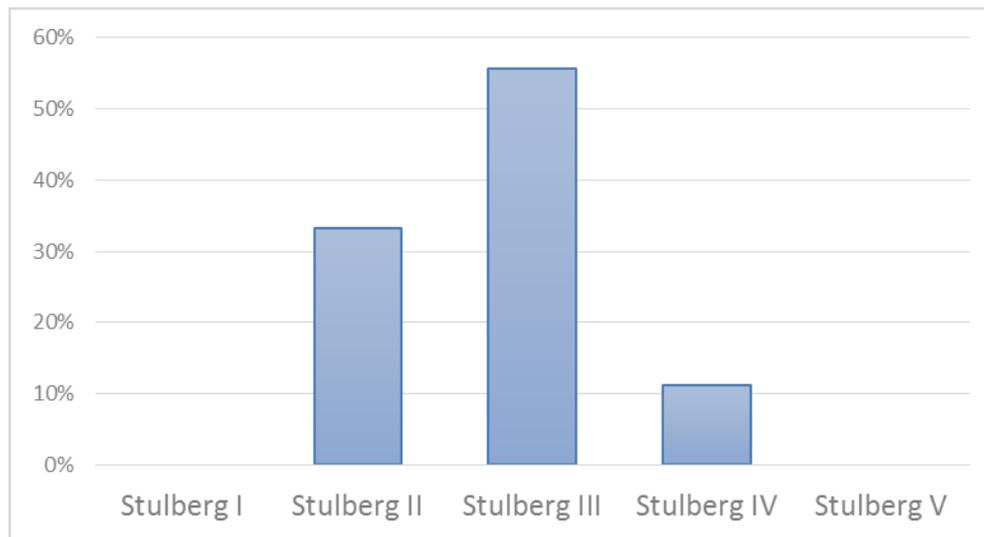


Figure 2: Stulberg grade of cases.

**DISCUSSION**

LCPD results from interruption of the blood supply to the capital femoral epiphysis resulting in osteonecrosis of the ossific nucleus. The underlying etiology has remained elusive. The goal of treatment is to maintain a concentrically reduced femoral head within the acetabulum in order to avoid or reduce the risk of femoral head deformation. Various surgical options have been used in LCPD including proximal femoral osteotomy, Salter innominate osteotomy, triple pelvic osteotomy, Chiari osteotomy and shelf acetabuloplasty <sup>1</sup>.

Shelf acetabuloplasty has been used to treat LCPD for two different surgical indications. When used as a salvage procedure, it provides relief from pain and better cover of the subluxed femoral head in patients with coxa magna and hinge abduction during the late stage of the disease<sup>9,10</sup>. It has also been performed for containment of extruded hips during the early stage of the disease<sup>11,12</sup>. For this latter indication, it is believed to be beneficial in remodelling the hip by preventing subluxation and supporting the acetabular labrum. It has been proven to have a stimulatory effect on lateral acetabular growth. Moreover, the shelf component of the labral support shelf acetabuloplasty gradually reabsorbs with time which prevents impingement of the hip<sup>5</sup>.

This prospective case series study aimed to evaluate the clinical and radiological outcomes of Spitzzy shelf acetabuloplasty for patients with LCPD above eight years of age at diagnosis in early active stage of the disease excluding cases with hinge abduction. It was conducted at Cairo University Children's Hospital (Abou El Reesh) in the period from January 2018 to May 2020.

A study by Catteral<sup>13</sup> showed that LCPD patients older than 8 years of age at onset of disease had a particularly poor prognosis. In this group of patients older than 8 years of age, about 50% had a poor outcome (defined as pain, restricted hip ROM and a flat broad femoral head). This is in contrast to just 16% of cases with poor outcome when considering all ages.

In this study, nine cases reached the healed stage of the disease. They were classified according to Stulberg classification as this was shown to be reliable even if the cases did not reach skeletal maturity<sup>15</sup>. Three cases (33.3%) were classified as Stulberg II, five cases (55.6%) were classified as Stulberg III and one case (11.1%) was classified as Stulberg IV. No cases were classified as Stulberg I or V. It seems that Spitzzy shelf acetabuloplasty have better results than non-operative treatment in patients over eight years of age at onset of the disease.

Wiig et al.<sup>17</sup> used femoral varus osteotomy for containment in 70 patients over six years of age with more than 50% femoral head involvement. Their results showed 30 cases (43%) with Stulberg I and II result, 32 cases (46%) Stulberg III and eight cases (11%) Stulberg IV and V result.

In a study by Kitakoji et al.<sup>18</sup>, 46 patients in early stages of LCPD and treated with femoral varus osteotomy were included. Ten patients were over nine years of age at disease onset. Stulberg results showed ten cases (21.74%) with group I outcome, 18 cases (39.13%) group II, ten cases (21.74%) group III and eight cases (17.39%) group IV. When considering patients over nine years of age, 30% of them showed Stulberg IV result.

Results of Spitzzy shelf acetabuloplasty seems to be superior to femoral varus osteotomy alone in the age group above eight years. This combination avoided the complications associated with femoral varus osteotomy in this age group.

Ishida et al.<sup>20</sup> reviewed the results of 32 patients (35 hips) with LCPD treated with Salter innominate osteotomy for containment. 19 patients were younger than seven years of age at diagnosis. Regarding Stulberg result at maturity, 11 hips (29.73%) were included in grade I, five (13.51%) in grade II, 13 (35.13%) in grade III, and six (21.63%) in grade IV. Patients over seven years of age showed statistically significant poorer results than those younger than seven years.

In Kitakoji et al.<sup>18</sup> study 30 patients in early stages of LCPD and treated with Salter innominate osteotomy were included. Ten patients were over nine years of age at disease onset. Stulberg results showed seven cases (23.33%) with group I outcome, 12 cases (40%) group II, six cases (20%) group III and five cases (16.67%) group IV. When considering patients over nine years of age, 30% of them showed Stulberg IV result. Complications reported with Salter osteotomy include increased pressure on the femoral head, lengthening of the leg, decreased hip flexion, joint stiffness and loss of fixation with displacement of the distal fragment<sup>18</sup>.

Results of Spitzzy shelf acetabuloplasty still seems to be superior to Salter innominate osteotomy alone in the age group above eight years. This combination avoided the complications associated with Salter innomintae osteotomy in this age group.

Li et al.<sup>11</sup> reviewed results of lateral shelf acetabuloplasty in a retrospective study with 51 patients. They used a modification of Staheli technique (added BMP to the graft). Radiographic assessment revealed significantly increased CEA, increased femoral head coverage, decreased medial joint space and decreased Sharp's angle.

Yoo et al.<sup>4</sup> studied Shelf acetabuloplasty in early stages of LCPD with reducible subluxation. They used a Catteral shelf technique. Radiographic assessment showed significantly increased acetabular depth, decreased medial joint space, increased CEA and decreased Sharp's angle.

Regarding the radiological outcomes in this study, CEA increased from a mean of 26.96 to 32.37 degrees. Sharp's acetabular angle decreased from a mean of 40.76 to 37.52 degrees. It appears that Spitzzy shelf acetabuloplasty has similar favorable radiologic outcomes as other shelf techniques and consistent with the results of other studies.

Jacob's et al.<sup>3</sup> included 43 patients in his study. Mean follow up was 3.7 years. Regarding Stulberg classification, 16 cases (37.2%) were classified as group II, 19 cases (44.19%) were classified as group III and 8 cases (18.6%) were classified as group IV. The mean age for patients with Stulberg IV outcome was significantly higher than other groups.

Carsi et al.<sup>12</sup> included 44 patients (45 hips) in his study. Regarding Stulberg classification, 17 cases (37.78%) were classified as group I and II, 21 cases (46.67%) were classified as group III and seven cases (15.56%) were classified as group IV. The mean age for patients with Stulberg IV outcome was significantly higher than other groups.

In this study, the mean age for cases with Stulberg IV outcome was nine years while the mean age for cases with Stulberg I-III outcome was 8.5 years. Although the mean age increased, the difference was not significant.

## CONCLUSION

We recommend Spitzzy shelf acetabuloplasty for the management of early stages of LCPD in patients with onset of the disease over eight years. This protocol of management has better results than nonoperative treatment in patients over 8 years of age at onset of the disease. It has

superior results to femoral varus osteotomy and Salter innominate osteotomy in the age group above eight years. It avoids the complications associated with them.

It can achieve a good Stulberg outcome (with only 11.1% of cases above Stulberg III) when used in early stages of LCPD. This is consistent with the results of other studies. It is better to start the treatment early before significant femoral head deformity happens as once femoral head collapse occurs, it is seldom regained.

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