# Combined Osteotomy in Patients with Severe Legg-Calve-Perthes Disease

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***Objective:*** *The purpose of the present study was to describe the clinical and radiographic results obtained with the combined osteotomy in patients with severe Legg-Calve-Perthes disease.*
***Material and Method:*** *During 2000 to 2010 patients with Legg-Calve-Perthes disease who intervened with combined osteotomy at Siriraj Hospital were evaluated. Clinical evaluation was categorized by Ratliff classification and radiographic evaluation was performed by Moss index, Lloyd Roberts classification and Stulberg classification.*
***Results:*** *Twenty patients intervened with combined osteotomy. There were nineteen males and one female with a mean age of 7.7 years. The average follow-up was 49 months. Nine had a Catterall III and eleven had a Catterall IV. According to Herring classification, fourteen patients were Herring B and six were Herring C. In accordance with the Ratliff classification, the postoperative clinical results: fifteen good, three fair and two poor. According to Mose scale, eight patients had good results, nine had fair results and three had poor results. According to the Lloyd-Roberts classification eight patients had good results, nine had fair results and three had poor results. Based on the Stulberg classification, there were ten patients in class II, nine in class III and one in class V.*
***Conclusion:*** *The surgical treatment for severe Perthes disease with the best expected outcome is still a challenge. According to the results reported here, the combined osteotomy is safe and effective procedure for patients with severe Perthes disease in whom the femoral head cannot be contained by conventional forms of treatment.*

***Keywords:*** *Legg-Calve-Perthes disease, Combined osteotomy, Double osteotomy*

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The Legg-Calve-Perthes disease (LCPD) is an idiopathic avascular necrosis of the femoral head, affecting children especially in males[1]. The main purpose of the management of LCPD is to prevent the femoral head deformity and the secondary degenerative osteoarthritis[2]. Treatment of LCPD ranging from conservative management to non-surgical and surgical methods. Goal of treatment is containment of the hip within the acetabular space. Theoretical that during the healing phase, the femoral head can remodel to a spherical shape and has more articular congruence[1].

The femoral varus osteotomy and the Salter innominate osteotomy are the traditional surgical treatment in LCPD. The femoral varus osteotomy is considered advantageous due to its safety. The disadvantages consist of limb shortening and weakness of the abductor mechanism. The advantages of Salter osteotomy are the coverage of the femoral head without limb shortening or weakness of the abductor mechanism. The disadvantage is increase joint pressure cause articular rigidity after surgery[1,3,4]. In patients with severely involved Catterall group 3 or 4 with lateral subluxation. These patients cannot be contained in a brace because of the wide abduction required and containment with a femoral varus osteotomy requires a marked varus deformity of the proximal femur. The amount of containment that is obtainable is increased when combined innominate and femoral osteotomies are performed. By addition of an innominate osteotomy of the Salter type, the amount of femoral neck-shaft varus necessary to produce containment is reduced. The advantages of the combined osteotomy for the treatment of severe LCPD are maximal containment of the femoral head avoiding the complications of each procedure and also avoid excessive varus. The prerequisite for combined osteotomy is a patient who probably would not achieve satisfactory containment from either femoral varus osteotomy or Salter osteotomy

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alone. Surgical time is increased, more blood loss and technically more difficult. Satisfactory anatomic and clinical results from this combined procedure are reported[5-9]. The purpose of the present study is to describe the clinical and radiographic results obtained with double osteotomy in patients with severe LCPD.

**Material and Method**

The present study of clinical and radiological evaluation of twenty patients treated with femoral varus osteotomy and Salter osteotomy at Siriraj Hospital during 2000 to 2010. Plain radiographs was used to evaluated the adequacy of containment by make AP radiograph with 20 degrees and 40 degrees of abduction or additional with intraoperative arthrogram. If AP radiograph with abduction 40 degrees could not give an adequate containment that mean excessive varus was necessary, combined osteotomy should be performed **(**Fig. 1A-D). Surgeries were performed by the same pediatric orthopedic surgeon. The osteotomies were performed through separate incision: the bikini modification of the Smith-Peterson anterolateral incision for the innominate osteotomy and lateral approach to the proximal femur for the intertrochanteric varus osteotomy. In femoral varus osteotomy insertion of angle blade plate was immediately distal to apophyseal growth plate of a greater trochanter. For the chisel insertion, if the chisel paralleled to guide pin, the 90 degrees angle blade plate would preduce a 90 degrees neck shaft angle, the authors sought to produce 110 degrees neck shaft angle thus a chisel placed 20 degrees off a guide pin axis add 20 degrees to 90 neck shaft angle resulting in a 110 degrees final angle. The Salter innominate osteotomy was performed after the femoral osteotomy using iliac bone graft and k-wire fixation. Intraoperative radiographs were taken to confirm containment, neck-shaft angle and angle blade plate placement. Following subcuticular skin closure, hip spica cast was applied.

At 6 weeks postoperatively, the innominated osteotomy k-wires were removed with patient under general anesthesia and gentle range of motion of the hips was begun. Non weight bearing with crutch was begun and the patient progressed to full weight-bearing when radiographs showed healing of both osteotomies. The femoral fixation plates were removed at 12-18 months postoperatively. All twenty patients were evaluated by chart and radiograph review and examined by one or both authors. For the initial diagnosis, patients'clinical status was assessed using the clinical and radiological classification of Catterall[10], Herring[11]. The population consisted of children with a Catterall classification graded as III or IV and Herring classification B and C. All twenty patients were evaluated clinically and radiographically on latest follow-up. At this evaluation, patients were classified according to the Ratliff classification[12], the Lloyd Roberts[13], the Mose index[14] and the Stulberg classification. Ratliff classification categorizes using three parameters (pain, limit range of motion and limp) the patients were rated as good if none of the finding were present, fair if one of the finding were present and poor if two or three of the finding were present[12]. The method of Mose[14] in determining the roundness of the femoral head, the result was good if femoral head deviated by < 1 mm, fair if 1-2 mm and poor if > 2 mm. The Lloyd Roberts classification[13] evaluates the sphericity and the containment of the femoral head within the acetabulum, good result implied the femoral

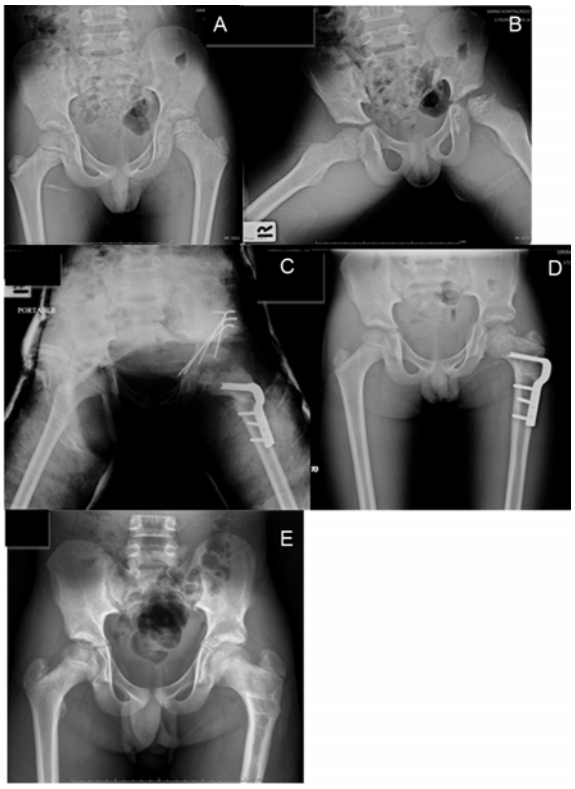


**Fig. 1** A) Show Perthes Lt. hip in 9 years old boy with Catterall III, B) AP radiograph with abduction 20 degrees shows inadequate containment of femoral head, C) Femoral varus osteotomy combine with Salter osteotomy, D) At follow-up 1 year with good coverage, E) At follow-up 4 years with good coverage and spherical shape of femoral head

head was spherical, congruous and fully contained and had minimal loss of epiphyseal height, fair result implied the head was not completely spherical but was congruent, had no more than one-fifth of the femoral head uncovered and mild loss of epiphyseal height, poor result had obvious flattening of the femoral head with loss of congruity, greater than one-fifth lateral extrusion and secondary acetabular changes. Stulberg classification, class I were normal hips, class II had a spherical femoral head with minor deformity of proximal femur or acetabulum, class III hips were congruous with mushroom head, class IV hips were congruous with flat femoral head, class V hips were incongruous with flat femoral head and normal acetabulum.

**Results**

There were nineteen males and one female in the study, with an average age of 7.7 years ranging between 3 and 10 years of age. The average follow-up was 4.1 years ranging between 2 and 8 years. Before surgery, all of them had a painful limping gait. Patients were classified radiologically before surgery as Catterall III (n = 9) and Catterall IV (n = 11); fourteen patients were classified as Herring B and six as Herring C. The radiological signs of head-at-risk consisting of lateral calcification of the epiphysis, lateral subluxation of the femoral head, metaphyseal cysts, physeal horizontalization and the Gage sign, were examined to evaluate the status of the patients, all patients had lateral subluxation and mean number of head at risk was 1.5 (Table 1). In accordance with the Ratliff classification, the postoperative clinical results: fifteen good, three fair and two poor. One patient had pain and two patients decrease in hip abduction. Based on the Stulberg classification, there were ten patients in class II, nine in class III and one in class V. According to the Mose index, in the present study, eight patients had good results, nine had fair results and three had poor results. According to the Lloyd-Roberts classification eight patients had good results, nine had fair results and three had poor results (Table 2). One patient who had poor clinical result by Ratliff classification had limb length discrepancy from physeal arrest which needed limb lengthening by Ilizarov technique and also had limping gait from abductor weakness. Another patient that had poor clinical result by Ratliff classification limit hip abduction resulting from excessive varus osteotomy which needed valgus correction osteotomy.

**Discussion**

The best treatment for severe LCPD remains uncertain. Most authors feel that some sort of surgical containment is indicated in severely affected hip with lateral subluxation and poorly femoral head coverage; however, the methods vary.

In 1981, Catterall reported on the outcome of LCPD in 97 hips, the final outcome was related to the extent of femoral head involvement. Based on these findings, Catterall developed his classification of disease severity and found that group I and II 92% had good results, whereas group III and IV 91% had predominantly poor results[16]. The studies of 20-40 years follow-up indicated that the majority of patients with healed LCPD had good functional result but long-term 40 years follow-up studies had demonstrated that residual femoral head deformity could lead to a high incidence of osteoarthritis lead to total hip arthroplasty[15]. This present study compare the results with the natural history studies by Catterall et al[10,16] as well as with results reported in the other published studies of operative treatment of severe LCPD[6,16-18]. The present study used clinical and radiographic rating systems established in previous studies to evaluate the results. Direct comparison with previous study is difficult because of the dissimilarity of the patient groups.

Olney and Asher concluded that the indications for the combined femoral and innominate osteotomy are Catterall group III or IV disease, two or more head-at-risk signs, Waldenstrom stage 1A or 1B, femoral head that can be completely contained in the acetabulum only with wide abduction and neck-shaft varus of less than 110 degrees is necessary for containment. If the patients meet these indications, the combined innominate and femoral osteotomy is indicated[17].

The Combined osteotomy in the treatment of LCPD was first reported in 1974 by Craig and Kramer, described the addition of an innominate osteotomy to the femoral osteotomy in order to provide adequate containment in patients with severe disease and lateral subluxation[5]. Olney and Asher reported of nine patients with severe LCPD treated with a combined osteotomy. Seven patients had a good clinical results at 4-years follow-up, two patients were fair because of persistent abductor weakness and a limp[17]. Chakirgil et al. reported 26 patients with severe LCPD and reported good results in 61% of the cases using a combined radiologic and clinical rating[3]. Crutcher and Staheli reported clinical evaluation by Ratliff classification in 14 patients with average follow-up of 8 years they obtained good results in 11 patients and fair results in

**Table 1.** Demographic Data of patients with Combined osteotomy

| Case | Age at presentation (years) | Side | Lateral pillar | Catterall | Head at risk | Age at operation(years) |
|---|---|---|---|---|---|---|
| 1 | 6 | Rt. | B | 4 | Lateral subluxation | 6 |
| 2 | 10 | Lt. | B | 3 | Lateral subluxation | 10 |
| 3 | 10 | Lt. | B | 4 | Lateral subluxation | 10 |
| 4 | 10 | Rt. | B | 3 | Lateral subluxation | 10 |
| 5 | 9 | Lt. | B | 3 | Lateral subluxation | 10 |
| 6 | 5 | Lt. | B | 3 | Lateral subluxation | 5 |
| 7 | 8 | Lt. | C | 4 | Lateral subluxation, gage sign,metaphyseal lesion,horizontal growth plate | 8 |
| 8 | 9 | Rt. | C | 4 | Lateral subluxation | 10 |
| 9 | 9 | Lt. | B | 4 | Lateral Subluxation | 10 |
| 10 | 6 | Lt. | B | 3 | Lateral subluxation | 6 |
| 11 | 6 | Lt. | C | 4 | Lateral subluxation, gage sign, metaphyseal lesion | 6 |
| 12 | 6 | Lt. | C | 4 | Lateral subluxation, gage sign, metaphyseal lesion | 6 |
| 13 | 10 | Lt. | B | 3 | Lateral subluxation | 10 |
| 14 | 8 | Lt. | B | 3 | Lateral subluxation, metaphyseal lesion | 8 |
| 15 | 8 | Lt. | B | 3 | Lateral subluxation, | 8 |
| 16 | 8 | Lt. | B | 3 | Lateral subluxation, | 8 |
| 17 | 7 | Lt. | B | 4 | Lateral subluxation, metaphyseal lesion | 7 |
| 18 | 8 | Lt. | B | 4 | Lateral subluxation, metaphyseal lesion | 8 |
| 19 | 6 | Lt. | C | 4 | Lateral subluxation, metaphyseal lesion | 6 |
| 20 | 3 | Lt. | C | 4 | Lateral subluxation, gage sign, metaphyseal lesion | 3 |

only three patients[6]. In the present study, accordance with the Ratliff classification, the postoperative clinical results: fifteen good, three fair and two poor. One patient has pain and two patients decrease in hip abduction. One patient that has limit hip abduction resulting from excessive varus osteotomy which needed valgus correction osteotomy. One patient who has poor clinical result by Ratliff classification has limb length discrepancy 4.5 cm from physeal arrest which needed limb lengthening by Ilizarov technique and also has limping gait from abductor weakness which is described in Lloyd-Roberts et al reported that limb shortening of more than 2.0 cm was strongly associated with a poor result and the authors attributed this to early physeal closure, rather than the varus osteotomy[13].

Based on the Stulberg classification, there were ten patients in class II, nine in class III and one in class V. These early results could indicate a long-term improvement in the prognosis of severe LCPD and a decrease in the probability to develop osteoarthritis as ten patients were rated Stulberg I or II, which implies good prognosis and low incidence of osteoarthritis. Nine patients were Stulberg III that implies fair prognosis and late presentation osteoarthritis and only

**Table 2.** Radiographic and Clinical results

| Case | Stulberg | Mose | Lloyd-Roberts | Clinical (Ratliff) | %Coverage | F/U (years) |
|---|---|---|---|---|---|---|
| 1 | 2 | good | good | good | 100 | 4 |
| 2 | 2 | good | good | good | 100 | 5 |
| 3 | 3 | fair | fair | good | 80 | 3 |
| 4 | 3 | fair | fair | good | 100 | 3 |
| 5 | 3 | fair | fair | good | 100 | 2 |
| 6 | 2 | good | good | good | 100 | 4 |
| 7 | 5 | poor | poor | poor | 70 | 5 |
| 8 | 3 | fair | fair | good | 90 | 2 |
| 9 | 3 | fair | fair | fair | 100 | 3 |
| 10 | 2 | good | good | good | 85 | 5 |
| 11 | 2 | fair | fair | good | 90 | 5 |
| 12 | 3 | good | good | good | 100 | 2 |
| 13 | 2 | good | good | good | 100 | 6 |
| 14 | 2 | good | good | good | 100 | 3 |
| 15 | 2 | good | good | good | 90 | 7 |
| 16 | 3 | poor | poor | poor | 70 | 8 |
| 17 | 3 | fair | fair | fair | 100 | 7 |
| 18 | 2 | fair | fair | good | 100 | 4 |
| 19 | 3 | poor | poor | fair | 100 | 4 |
| 20 | 2 | fair | fair | good | 100 | 6 |

one patient was Stulberg V.

According to the Mose index, in the present study, eight patients have good results, nine have fair results and three have poor results. According to the Lloyd-Roberts classification eight patients have good results, nine have fair results and three have poor results. The present study has comparable results compare to other studies and much improve the result when compare to the study of Catterall[16].

In the present study, progressive spherical remodeling was occurred, despite preoperative femoral head deformity, confirming the concept that adequate containment can improve femoral head sphericity. Most of our patients had femoral head deformity at the time of surgery and hip joint congruity was still reestablished in the majority of patients (Fig. 1A-D). Even the older patients had enough remodeling left to reestablish hip congruity. The authors' believe, however, that it is important to obtain containment before the healing stage of the disease so that bone and cartilage remodeling can occur. The potential disadvantages of the combined osteotomy are that it is technically more difficult procedure than either the femoral or innominate procedures alone, longer operative time and more blood loss.

In the authors' experience, combined innominate and femoral osteotomy has been effective as a salvage operation for severe LCPD in cases where nonoperative treatment had a poor prognosis and either femoral or pelvic osteotomy alone would be inadequate. This is a safe procedure that can provide excellent femoral head containment without increased hip stiffness or significant limb shortening and also has the evidence that this method of containment can result in significant spherical remodeling of a previously deformed femoral head (Fig. 1A-D). In prospective, more cases and longer follow-up studies in patients with this disease are needed to increase the evidence for decision-making in order to determine the best treatment for patients with severe presentation LCPD.

**Potential conflicts of interest**

None.

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## การรักษาภาวะหัวกระดูกสะโพกตายจากการขาดเลือดในเด็กโดยวิธีผ่าตัดกระดูกเบ้าสะโพกร่วมกับผ่าตัดกระดูกส่วนใต้คอสะโพก

**พีระจิตร เอี่ยมโสภณา, กมลพร แก้วพรสวรรค์**

***วัตถุประสงค์:*** *เพื่อศึกษาผลการรักษาภาวะหัวกระดูกสะโพกตายจากการขาดเลือดในเด็กโดยวิธีผ่าตัดกระดูกเบ้าสะโพกร่วมกับผ่าตัดกระดูกส่วนใต้คอสะโพก โดยศึกษาผลการรักษาทั้งจากทางภาพถ่ายทางรังสีและการตรวจร่างกายผู้ป่วย*

***วัสดุและวิธีการ:*** *ผู้ป่วยจำนวน 20 ราย ที่ได้รับการรักษาด้วยวิธีผ่าตัดกระดูกเบ้าสะโพกร่วมกับผ่าตัดกระดูกส่วนใต้คอสะโพกตั้งแต่ปี พ.ศ. 2543-2553 ที่โรงพยาบาลศิริราชจะได้รับการตรวจติดตามการรักษาทั้งจากการตรวจร่างกายและเอกซเรย์ เพื่อศึกษาผลการรักษาโดยวัดผลจากการตรวจร่างกายโดยประเมินโดย Ratliff classification และศึกษาภาพถ่ายทางรังสีและประเมินผลการรักษาด้วย Stulberg classification, Moss index และ Lloyd Roberts scale*

***ผลการศึกษา:*** *ผู้ป่วยมีภาวะหัวกระดูกสะโพกตายจากการขาดเลือด แบ่งตาม Catterall พบว่าเป็นระดับสามจำนวน 9 คน ระดับสี่จำนวน 11 คน ถ้าแบ่งตาม Herring จะพบว่าเป็นระดับสองจำนวน 14 คน ระดับสามจำนวน 6 คน เมื่อทำการวัดผลทางการรักษาจากการใช้งานสะโพกและการเดิน โดยประเมินด้วย Ratliff classification จะพบว่าผู้ป่วย 15 คนได้ผลดี 4 คนได้ผลปานกลาง และมีผู้ป่วย 1 รายที่ได้ผลไม่ดี และเมื่อประเมินการรักษาด้วยภาพถ่ายรังสีเมื่อผู้ป่วยสิ้นสุดการเจริญเติบโตเพื่อประเมินการเกิดข้อเสื่อมในอนาคตโดยใช้ Stulberg classification พบว่าผู้ป่วย 10 คนอยู่ในระดับที่สอง 9 คนอยู่ในระดับที่สาม และ 1 คนอยู่ในระดับห้า*

***สรุป:*** *การรักษาภาวะหัวกระดูกสะโพกตายจากการขาดเลือดที่เป็นรุนแรงนั้นยังเป็นประเด็นที่น่าสนใจในการรักษาเพื่อให้หัวสะโพกมีภาวะผิดรูปน้อยที่สุดเพื่อป้องกันภาวะข้อสะโพกเสื่อมในอนาคต การผ่าตัดกระดูกเบ้าสะโพกร่วมกับการผ่าตัดกระดูกส่วนใต้คอสะโพกเป็นวิธีการรักษาที่ปลอดภัยและได้ผลดีซึ่งเป็นทางเลือกที่ดีในผู้ป่วยที่หัวกระดูกสะโพกผิดรูปมากจนไม่สามารถใช้การรักษาด้วยการใช้อุปกรณ์หรือการผ่าตัดเพียงจุดเดียวได้*