Results of Surgical Treatment of Coxa Vara in Children: Valgus Osteotomy with Angle Blade Plate Fixation

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Background: *Coxa vara is a rare condition. Surgical correction of coxa vara has been challenging. A few reports present correction coxa vara in multiple causes. In this retrospective study, the authors reported the results of surgical treatment of coxa vara by valgus osteotomy with angle blade plate fixation in 11 children with 12 hips.*

Material and Method: *Since 2002-2011, 11 children with 12 hips with coxa vara were reviewed retrospectively by medical chart and radiographic data after surgical treatment. All of them were operated by valgus osteotomy and fixation with angle blade plate. All of them had been hip spica cast between 8-12 weeks after surgery. Neck-shaft angle, Hilgenreiner-epiphyseal angle, leg-length discrepancy and Harris hip score were evaluated at preoperative, postoperative, and final follow-up.*

Results: *Twelve coxa vara; 4 malunion femeral neck fracture, 4 congenital coxa vara, 2 spondyloepiphyseal dysplasia and 1 multiple epiphyseal dysplasia were operated on in 11 patients. One spondyloepiphyseal dysplasia had bilateral coxa vara. The average age at surgery was 9.5 years (range, 7-12 years). The average time of follow-up was 4.2 years (range, 3-7 years). The average neck-shaft angle was changed significantly from 79.8 to 123.7 degrees, the Hilgenreiner-epiphyseal angle was changed significantly from 70 to 39.3 degrees and leg-length discrepancy was changed significantly from 2.2 to 1.7 centimeters at final follow-up. The average Harris Hip score was improved significantly from 68 at preoperative to 96 at final follow-up. No complication or recurrence was found.*

Conclusion: *Surgical treatment of coxa vara is uncommon treatment. The aims of treatment were to change the stress in the neck femur from shearing force to compression force and also improving shortening that could reduce incidence of further fracture and osteoarthritis. The Hilgenreiner-epiphyseal angle should be closed to 38-40 degree or less after surgery.*

Keyswords: *Coxa vara, Neck-shaft angle, Hilgenreiner-epiphyseal angle, Angle blade plates*

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Coxa vara is described as any decrease in the femoral neck-shaft angle below the normal[1], below 110%[2]. This condition could be congenital, characterized by a primary cartilaginous defect in the femoral neck or from secondary coxa vara that related with trauma, infection, pathologic bone disorder, and also with skeletal dysplasia[1,4].

The patients with coxa vara typically present with limping gait and leg-length discrepancy in unilateral case. In untreated, patients could have stress fracture or possibly hip joint degeneration due to increasing tensile force on the superior femoral neck and also genu valgum[1]. Since coxa vara is a rare condition, very few reports described surgical correction of coxa vara. The objective of this study is to report the results of the surgical correction in coxa vara in children.

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Material and Method

This is the retrospective study by reviewing the medical chart and the radiographic data of the coxa vara patients who underwent proximal femoral valgus osteotomy in Siriraj hospital between 2002-2011. Excluding criteria was incomplete patient information, incomplete radiographic data, follow-up time less than 2 years, age at surgery more than 20 years. The radiographic parameter including the neck-shaft angle, Hilgenreiner-epiphyseal angle were evaluated in the standard AP radiographic x-ray of hips. The leg-length discrepancies were evaluated by different true leg length measurement of both sides. All these parameters were reviewed and evaluated at preoperative, 8-12 weeks postoperative, then every 6 months-1 year until final follow-up. The Harris hip scores were reviewed at preoperation, then every 6 months-1 year until final follow-up.

The present study was analyzed with the

Wilcoxon signed-rank test, registered and approved by the Siriraj Hospital ethic committee.

Results

Eleven patients (7 male, 4 female) with 12 coxa vara were included the study. All presented with limping gait due to leg-length discrepancy. One case presented with waddling gait due to bilateral hip-involvement. These patients were as follows: 4 malunion femoral neck fracture, 4 congenital coxa vara, 2 spondylo-epiphyseal dysplasia and 1 multiple epiphyseal dysplasia. One spondyloepiphyseal dysplasia had bilateral involvement. All was performed proximal femoral valgus osteotomy with pediatric angle blade plate. The average age at surgery was 9.5 years (range, 7-12 years). The average time of follow-up was 4.2 years (range, 3-7 years).

In radiographic parameter results (Table 1), the average neck-shaft angle at preoperative, 8-12 weeks postoperative and final follow-up were 79.8°, 121.8° and 123.7°, respectively (Fig. 1-3). The average Hilgenreiner-epiphyseal angle at preoperation, 8-12 weeks postoperation and final follow-up were 70°, 40.5° and 39.3°, respectively. The average leg-length discrepancy preoperative, 8-12 1.7 centimeters, respectively. The comparison of neck-shaft angle, Hilgenreiner-epiphyseal angle and leg-length discrepancy between preoperative and 8-12 weeks postoperation was statically significant different ($p \leq 0.05$) but between postoperative and final follow-up was not statically significant different ($p > 0.05$).

The average correction of the neck-shaft angle at 8-12 weeks postoperation and final follow-up was 42° and 45.8°, respectively. The average correction of Hilgenreiner-epiphyseal angle at 8-12 weeks postoperation and final follow-up was 29.5° and 30.7° respectively. The average leg-length discrepancy correction at 8-12 weeks postoperation and final follow-up 0.6 and 0.5 centimeters, respectively.

The average of Harris hip score preoperation was 68 (range, 53.2-72), 6 months postoperation was 91.6 (range, 86-97.7) and final follow-up was 96 (range, 86-110). There was statically significant different ($p \leq 0.05$) of Harris hip score between preoperative and postoperative and also between postoperative and final follow-up. No complication and recurrence were found after surgery.

Discussion

Generally patients having coxa vara have the problems of limping gait with leg-length discrepancy

Table 1. Preoperation, postoperation and the final follow-up data

Case	Diagnosis	Sex	Side	Age	Year F/U	Neck-shaft angle			Hilgenreiner-epiphyseal angle			Leg-length discrepancy(centimetres)		
						Pre-operative	Post-operative	Final follow-up	Pre-operative	Post-operative	Final follow-up	Pre-operative	Post-operative	Final follow-up
1	SED	M	R	7	3.4	80	131	130	75	39	41	0	0	0
			L			85	135	141	80	38	37	0	0	0
2	SED	M	L	7.4	3.6	85	120	130	75	39	38	2.6	1.3	1.5
3	MED	M	R	10.5	5.5	65	115	120	73	58	53	2	1.7	1.8
4	MFNF	F	L	12	3.8	69	123	124	70	40	42	2	1	0.7
5	MFNF	F	R	11.6	3.4	70	120	123	56	41	40	2	2.2	2.2
6	MFNF	M	R	10	5.7	85	124	124	61	37	35	2	0.7	1
7	MFNF	M	L	8	3	65	105	110	65	39	38	2.8	2.5	2.7
8	CCV	M	L	11.5	3.5	92	125	127	65	38	37	1.8	1.2	1.4
9	CCV	M	L	9	7	93	120	122	68	32	33	2	1.5	1.7
10	CCV	M	R	10	4.2	95	123	123	66	38	38	2.2	1.9	2
11	CCV	F	L	7.6	3.1	73	120	110	86	47	39	2.1	1.8	1.8
		Mean		9.5	4.2	79.8	121.8	123.7	70	40.5	39.3	2.2	1.6	1.7

SED = spondyloepiphyseal dysplasia; MED = multiple epiphyseal dysplasia; MFNF = malunion femoral neck fracture; CCV = Congenital coxa vara

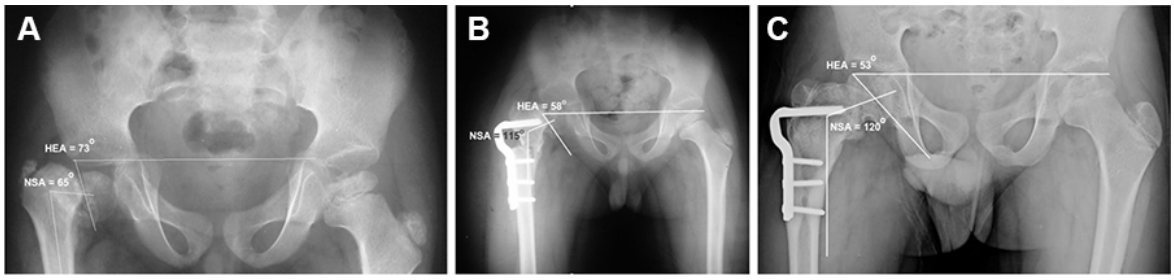

Fig. 1 The radiograph both hips of 10-year-old male came with coxa vara from multiple epiphyseal dysplasia (third case) show Hilgenreiner-epiphyseal angle and neck-shaft angle at preoperative, 12 weeks postoperative and final follow-up at 5 years postoperative.

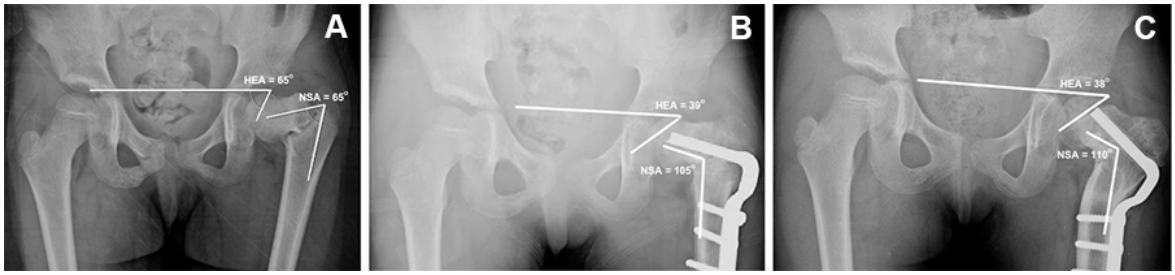

Fig. 2 The radiograph both hips of 8-year-old male came with coxa vara from malunion femoral neck fracture (Case No. 7) show Hilgenreiner-epiphyseal angle and neck-shaft angle at preoperative, 12 weeks postoperative and final follow-up at 3 years postoperative.

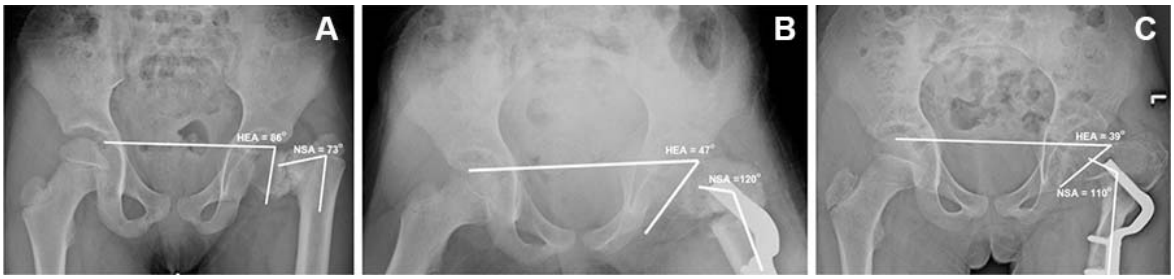

Fig. 3 The radiograph both hips of 7-year-old female came with congenital coxa vara (Case No. 11) show Hilgenreiner-epiphyseal angle and neck-shaft angle at preoperative, 12 weeks postoperative and final follow-up at 3 years postoperative.

in unilateral and waddling gait in bilateral involvement. The shearing force of the femoral neck cause stress fracture, possibly dysplastic change in the hip joint, worsened the spinal deformity and possibly genu valgum[1,4]. Therefore, the surgical treatment of coxa vara is very important to prevent the pathological condition resulting from a disease.

The indication of surgery of coxa vara has confidence in hip symptoms, degree of neck-shaft angle and Hilgenreiner-epiphyseal angle. The valgus proximal femoral osteotomy has been gold standard treatment of coxa vara.

Pauwels described the concept of osteotomy to convert unstable shear force to compression forces[8]. There are many types of fixation devices for hip osteotomy including angle blade plate, dynamic sliding hip screws, tension band wiring and external fixator[2,7-9].

There are literatures about the type of implant used to improve stability at osteotomy site. Abdul Qayyum Khan et al reported results of valgus osteotomy proximal femur with sliding hip screw in treating coxa vara from nonunion femoral neck fracture[9]. Francois Fassier et al used the combination of the Kirschner

wires and the rod to provide stability of fixation after correct coxa vara in children with osteopenic bone[6]. This success could be done by technically demanding, but difficult to apply an intramedullary nail in bowing proximal femur.

Many authors agree that the postoperative Hilgenreiner-epiphyseal angle obtained is the most important predictive factor of recurrence. Desai and Johnson reported 12 hips, a postoperative Hilgenreiner-epiphyseal angle of 35 degrees gave consistently satisfactory results with no recurrence[11]. Cordes et al reported 14 cases, an excellent result could be expected in the Hilgenreiner-epiphyseal angle was corrected to 40 degrees or less[12]. Carroll et al reported that when the Hilgenreiner-epiphyseal angle was corrected to less than 38 degrees, 95% of children had no coxa vara recurrence. The age at the time of surgery, type of surgery, type of implant, and etiology were not related to recurrence[5].

In the present study, the authors found that coxa vara upcoming from difference causes, would be treated in the same fashion by valgus osteotomy with angle blade plates.

The report of recurrence rate of coxa vara after surgical treatment with angle blade plate was rage 0-50%[1,5,6,11,12]. Many literatures[1,5,6,11,12] reported that Hilgenreiner-epiphyseal angle should less than 38°-40° otherwise there was a chance of recurrence rate. The present study was not much different to other studies which no hips needed to be revised even the average of Hilgenreiner-epiphyseal angle was about 39.3° at final follow-up. Between postoperative and final follow-up, the authors found no statically significant difference of neck-shaft angle, Hilgenreiner-epiphyseal angle and leg-length discrepancy that mean our technique and instrument the authors used can hold the correction until the last follow-up. However the Harris hip scores improved postoperatively and final follow-up significantly, due to improve functional activity of patient after corrective treatment.

The pitfalls of our surgical technique are not only corrected via valgus osteotomy with angle blade plate, but also by performing adductor tenotomy to archive surgical treatment. During plate fixation, the authors preferred a little bit of femoral external rotation by notice knee and foot position during surgery. The Hilgenreiner-epiphyseal angle should be less than 38°-40° to decrease change of recurrent rate of coxa vara, which means the more decreasing angulation of femoral epiphyseal plate, the more decreasing shearing fore of femoral neck.

Conclusion

Surgical treatment of coxa vara in the children with pediatric angle blade plate can be done well in different causes. The aim of treatment were to change the stress in the neck femur from shearing force to compression force and also improving shortening that could reduce incidence of further fracture and osteoarthritis. The Hilgenreiner-epiphyseal angle should be closed to 38-40 degree or less after surgery. No recurrence was found.

Potential conflicts of interest

None.

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ผลการรักษาผู้ป่วยเด็กโรค coxa vara โดยการผ่าตัดวิธี valgus osteotomy และยึดตรึงกระดูกด้วย Angle blade plate

จตุพร โชติกวณิชย์, ดวงใจ ลี้ประกอบบุญ, พีระจิตร เอี่ยมโสภณา, กมลพร แก้วพรสวรรค์

ภูมิหลัง: *ภาวะ coxa vara ในเด็กเป็นภาวะที่พบได้น้อยมากและมีจำนวนรายงานการรักษาโดยวิธีการผ่าตัดน้อย*

วัตถุประสงค์: *รายงานผลการรักษาโดยวิธีการผ่าตัด valgus osteotomy ในผู้ป่วย coxa vara ในเด็ก*

วัสดุและวิธีการ: *การศึกษาย้อนหลังผู้ป่วย coxa vara อายุน้อยกว่า 20 ปี และได้รับการผ่าตัด valgus osteotomy ตั้งแต่ พ.ศ. 2545-2554 โดยเก็บข้อมูลอายุ เพศ ภาพถ่ายรังสีของสะโพก การสั้นยาวของขาและคะแนน Harris Hip Score ก่อนและหลังผ่าตัด*

ผลการรักษา: *พบผู้ป่วย 11 ราย (เป็นชาย 8 ราย หญิง 3 ราย) ทุกรายได้รับการผ่าตัด valgus osteotomy ด้วย angle blade plate ได้รับการวินิจฉัยเป็น congenital coxa vara 4 ราย malunion of femoral neck fracture 4 ราย spondyloepiphyseal dysplasia 2 ราย (มี 1 รายเป็นสองข้าง) เป็น multiple epiphyseal dysplasia 1 ราย อายุเฉลี่ยที่ทำการผ่าตัด 9.5 ปี (7-12 ปี) ระยะเวลาติดตามเฉลี่ย 4.2 ปี (3-7 ปี) สามารถแก้ไข neck-shaft angle จาก 79.8 องศา เป็น 123.7 องศา แก้ไข Hilgenreiner-epiphyseal angle จาก 70 องศา เป็น 39.3 องศา แก้ไขระยะสั้นยาวเฉลี่ยของขาจาก 2.2 ซม. เป็น 1.7 ซม. และ Harris hip score เฉลี่ยก่อนผ่าตัดจาก 68 เพิ่มเป็น 96 หลังผ่าตัดไม่พบภาวะแทรกซ้อนหรือการกลับมาเป็นใหม่ภายหลังจากการผ่าตัด*

สรุป: *ภาวะ coxa vara เป็นภาวะที่พบน้อยมากและมีจำนวนรายงานการรักษาโดยวิธีการผ่าตัดน้อยเช่นกัน การรักษาโดยการผ่าตัด valgus ostetomy สามารถทำให้ผู้ป่วยมีอาการดีขึ้น และสามารถลดอุบัติการณ์การเกิด stress fracture และข้อสะโพกเสื่อมในอนาคตได้ Hilgenreiner-epiphyseal angle หลังผ่าตัดควรได้มุมใกล้เคียง 38-40 องศาหรือน้อยกว่า และจากการติดตามเฉลี่ย 4.2 ปี ยังไม่พบการกลับมาเป็นใหม่ภายหลังจากการผ่าตัด*