Managment of congenital knee dislocation by gradual reduction with serial casting

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Background
Congenital knee dislocation (CKD) is deformity of the knee characterized by unnatural hyperextension with severely restricted knee flexion. It may either be idiopathic or a part of any syndrome (Larsen's syndrome, myelomeningocele, and arthrogryposis multiplex congenita). As the incidence of CDK is very low (~1/100 000 live births, which is about 1% of the incidence of congenital hip dislocation).
Aim
To identify the results of conservative management of the group of CKD at birth, especially grade I and grade II according to Tarek CDK grading system (Abdelaziz and Samir grading of CDK) and identify the problems encountered during the process.
Patients and methods
Between January 2016 and February 2021, 24 infants with 34 CDK were treated at Al-Azhar University Hospital, Assiut branch. Age at the time of initial treatment ranged from 3 to 45 days, average 17 days. Fourteen infants were male and 10 infants were female. Eight cases were affected on the right side, six cases were affected on the left side, and 10 cases were affected bilaterality.
Follow-up ranged from 1 to 3 years, average 2.3 years.
The serial casting was started weekly, aiming to achieve more than 90° passive flexion, the number of the cast ranged from one to six casts, average three casts. Then, the cast was discontinued and a back splint has been given to the 14 patients to be used at nighttime only.
Results
All parents were satisfied with the outcome. Satisfaction was assessed by asking the parent(s) to grade their child's condition at the final follow-up on a scale of 0 to 5, with '0' meaning totally unsatisfied and '5' meaning extremely satisfied. Parent(s) who graded their child at '3 or more' were considered satisfied. Twenty-two knees achieved excellent results, 10 knees achieved good results, and two knees achieved fair results. All knees that achieved excellent results were grade I/grade II and had been treated by serial casting only.
The cast was changed every 1 week, average duration of cast was 21 days.
The only two knees were grade III that underwent V-Y quadricepsplasty and had excellent results.
Conclusion
If CDK was diagnosed early after birth and timely treatment initiated successful, conservative management can be easily done even in the higher grades of classification of CKD.

Keywords:
congenital knee dislocation, V-Y quadricepsplasty, gradual, correction, cast, children

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Introduction

Congenital knee dislocation (CKD) is a deformity of the knee characterized by unnatural hyperextension with severely restricted flexion of the knee. It may either be idiopathic or a part of any syndrome (Larsen's syndrome, myelomeningocele, and arthrogryposis multiplex congenita) [1–3]. As the incidence of CDK is very low (~1/100,000 live births [4,5], which is about 1% of the incidence of congenital hip dislocation [6]), so many pediatricians and orthopedicians often have not seen even a single such case. The deformity may be unilateral or bilateral and more common in girls, but some literature reports equal distribution [7–9]. The healthcare providers are not able to explain and guide the parents regarding the prognosis and management of this congenital deformity due to the lack of knowledge and experience regarding the management. The aim of

this study was identifying the results of conservative management of the group of CKD at birth, especially grade I and grade II according to Tarek CDK grading system (Abdelaziz and Samir [1] grading of CDK) and identify the problems encountered during the process.

Patients and methods

Between January 2016 and February 2020, 24 infants with 34 CDK were treated at Al-Azhar University Hospital, Assiut branch. Age at the time of initial treatment ranged from 3 to 45 days, average 17 days. Fourteen infants were male and 10 infants were female. Eight cases were affected on the right side, six cases were affected on the left side, and 10 cases were affected bilaterality. Follow-up ranged from 1 to 3 years, average 2.3 years (see Table 1). The study was approved by the Ethics Committee of AL-Azhar Faculty of Medicine, Assiut, Egypt. All participants were given informed consent.

Informed consent for publication of this cases and any accompanying images have be provided by the patient's parents.

According to Tarek CDK grading system (Abdelaziz and Samir [1] grading of CDK) (see Table 2). This was based on our observation that the range of passive knee flexion (compared with the degree of hyperextension and the femoro-tibial relationship on radiograph) (>90° as GI, 30–90° as GII, and <30° as GIII), 25 CDK were GI, seven CDK were GII, and two CDK were GIII.

The serial weekly casting was started aiming to achieve more than 90° passive flexion, the number of the cast ranged from one to six casts, average three casts, the cast was changed every 1 week, and average duration of cast was 21 days. Then the cast was discontinued and a back splint has been given to the fourteen patients to be used at nighttime only. The splint is removed during daytime or whenever the child is awake to encourage active flexion and extension at the knee.

Results

Between January 2016 and February 2020, 24 infants with 34 CDK were treated at Al-Azhar University Hospital, Assiut branch. Age at the time of initial treatment ranged from 3 to 45 days, average 17 days. Fourteen infants were male and 10 infants were female. Eight cases were affected on the right side, six cases were affected on the left side, and 10 cases were affected bilaterality. Follow-up ranged from 1 to 3 years, average 2.3 years (see Table 1).

Statistical analysis

According to Tarek CDK grading system (Abdelaziz and Samir [1] grading of CDK) (see Table 2). This was

Table 1 Patient details

Numbers	Age/day	Sex	Side	Number of cast	Duration of cast/day	Orthosis	Follw-up/year
1	7	F	R	3	21	+	3
2	3	M	L	2	14	–	3
3	10	F	Bil	3	21	+	3
4	7	F	R	3	21	+	3
5	6	M	L	2	14	–	3
6	15	F	Bil	6	42	–	2
7	18	M	Bil	2	14	+	3
8	45	M	R	4	28	+	2
9	34	M	Bil	3	21	+	2
10	22	M	Bil	2	21	–	1
11	18	F	R	1	7	+	1
12	22	M	L	1	7	–	2
13	7	F	R	3	21	+	3
14	3	M	L	2	14	–	3
15	10	F	Bil	3	21	+	3
16	7	F	R	3	21	+	3
17	6	M	L	2	14	–	3
18	15	F	Bil	4	28	–	2
19	18	M	Bil	2	14	+	3
20	45	M	R	4	28	+	2
21	34	M	Bil	3	21	+	2
22	22	M	Bil	2	14	–	1
23	18	F	R	1	7	+	1
24	22	M	L	1	7	–	2
Mean	17	–	–	3	21	–	2.3

Bil, bilateral; F, female; M, male.

based on our observation that the range of passive knee flexion (compared with the degree of hyperextension and the femoro-tibial relationship on radiograph) (>90° as GI, 30–90° as GII, and <30° as GIII), 25 CDK were GI, seven CDK were GII, and two CDK were GIII.

All parents were satisfied with the outcome and all children were able to walk independently before the age of 2 years. Satisfaction was assessed by asking the parent(s) to grade their child's condition at the final follow-up on a scale of 0 to 5, with '0' meaning totally unsatisfied and '5' meaning extremely satisfied (see Table 3). Parent(s) who graded their child at '3 or more' were considered satisfied. Twenty-two knees achieved excellent results, 10 knees achieved good results, and two knees achieved fair results (see Table 4 and Figs 1, 2). All knees that achieved excellent results were GI/II and had been treated by serial casting only as early as possible. The cast was changed every 1 week, average duration of the cast was 21 days. The only two knees were GIII that underwent V-Y quadricepsplasty (VYQ) and had excellent results.

All four criteria need to be fulfilled to qualify for a certain grade. Mild/gross depends on whether the activities of daily living are affected or not. If any single criterion was not fulfilled, the result was downgraded.

Table 2 Tarek CDK grading system

Grades	Range of passive flexion	Radiology
GI	90°	Simple recurvatum
GII	30–90°	Subluxation/dislocation
GIII	<-30°	Dislocation

Table 3 Modified knee function scoring system

Grades	Flexion (range)	Extension (power)	Instability	Pain
E	Full	G5	Nil	Nil
G	>90°	G3	Mild	Mild
F	45–90°	G2	Mild	Mild
P	<45°	G2	Gross	Severe

E, excellent; F, fair; G, good; P, poor.

Discussion

If CDK was diagnosed early after birth and timely treatment initiated successful, conservative management can be easily done. For this, awareness should be made in both the pediatric and orthopedic community. The radiologist should be watchful of CDK in the prenatal ultrasound due to development in the second half of pregnancy [10]. In examination of CDK, it may be a part of a syndrome, so, we must exclude in such cases other associated anomalies.

Two classifications well be known, one by Abdelaziz and Samir [1] and another by Mehfershan *et al.* [10,11], are freely available in the literature to guide the treatment plan and to grade the severity of CDK. However, we found the latter is better in treatment protocol and individual case assessment and to be less rigid [12].

Assessment of growth plate and iatrogenic fractures by radiological investigations should be done before and after treatment. Both early and late complications of CDK like cruciate ligament abnormality [13], knee instability [5], and limb-length discrepancies should be discussed with parents of the child well before starting treatment.

Haga *et al.* [14] published a study in 1997 in which they advised wait-and-watch strategy for 1 month in nonsyndromic cases as spontaneous reduction of CKD could occur. Conservative management in similar cases was advocated by Bhatia *et al.* [15], while Cheng and Ko [8] and Bhatti *et al.* [16] have proposed initiating the reduction treatment as early as 24 h after birth.

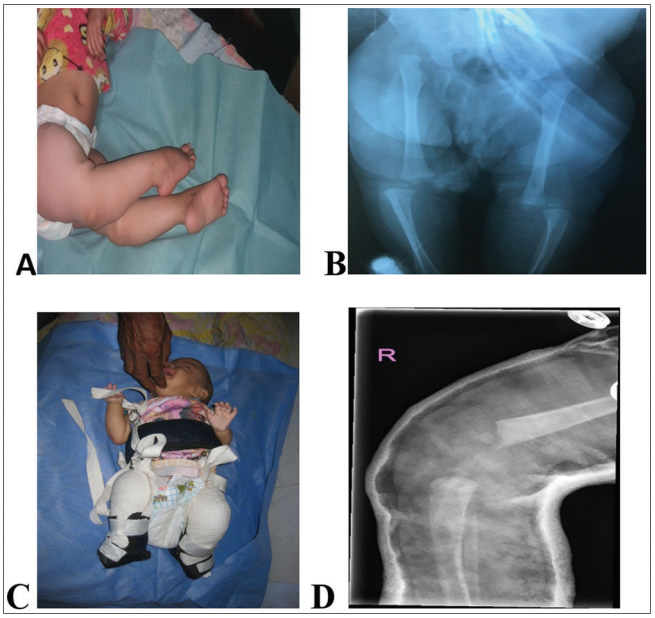
We can wait for at least a week to allow the delicate skin of the newborn to mature enough to be able to tolerate casting like as in ponseti casting for clubfoot.

Table 4 Results

Patients	Range of flexion	Power of extension	Instability	Pain	Result	Complications
1R	0–110	G5	Nil	Nil	G	
2R	0–110	G3	Mild	Nil	G	
5R	0–140	G5	Nil	Nil	E	
6R	0–140	G5	Nil	Nil	E	
3R	0–95	G3	Nil	Nil	G	
1L	0–100	G3	Mild	Nil	G	
7L	0–140	G5	Nil	Nil	E	
3L	0–100	G3	Nil	Nil	G	
4L	0–140	G5	Nil	Nil	E	
1R	0–60	G2	Mild	Nil	F	Dislocation in the cast with revision VYQ
1L	0–60	G2	Mild	Nil	F	Dislocation in the cast with revision VYQ

E, excellent; F, fair; G, good; L, left; R, right; VYQ, V-Y quadricepsplasty.

Figure 1



Male child, 16-day-old with bilateral CDK. (a) Photo of the child before serial casting, (b) radiograph of the child before serial casting, (c) serial casting, (d) radiograph of the child with casting.

Figure 2

Female child, 18-day-old with right CDK (GIII). (a) Photo of the child before serial casting, (b) radiograph of the child after serial casting, (c) photo of the child after VYQ, and (d) radiograph of the child after VYQ.

Conservative methods, including serial manipulation and casting in management of children with CKD, are started early.

In our opinion, surgical procedures should be reserved for resistant cases, especially in older age.

In our study, 24 infants with 34 CDK were treated at Al-Azhar University Hospital, Assiut branch. Age at the time of initial treatment ranged from 3 to 45 days, average 17 days. Fourteen infants were male and 10 infants were female. Eight cases were affected on the right side, six cases were affected on the left side, and 10 cases were affected bilaterally. Follow-up ranged from 1 to 3 years, average 2.3 years (Table 1).

According to Tarek CDK grading system (Abdelaziz and Samir [1] grading of CDK) (Table 2). This was based on our observation that the range of passive knee flexion (compared with the degree of hyperextension and the femoro-tibial relationship on radiograph) (>90° as GI, 30–90° as GII, and <30° as GIII), 25 CDK were GI, seven CDK were GII, and two CDK were GIII.

According to Tarek CDK grading system (Abdelaziz and Samir [1] grading of CDK), grade I and grade II were managed by conservative treatment but grade III was managed by surgical treatment.

Twenty-two knees achieved excellent results, 10 knees achieved good results, and two knees achieved fair results (Table 4 and Figs 1, 2). All knees that achieved excellent results were GI/II and had been treated by serial casting only as early as possible. The cast was changed every 1 week, average duration of the cast was 21 days. The only two knees were GIII that underwent VYQ and had excellent results.

Conclusion

If CDK was diagnosed early after birth and timely treatment initiated successful, conservative management can be easily done even in the higher grades of classification of CKD.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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