

# Clinical Outcomes of Managing Congenital Knee Dislocation: An Observational Study

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## ABSTRACT

**Objective:** This study aims to assess the effectiveness, complications, and recurrence rates of various treatment approaches for congenital knee dislocation (CDK) in paediatric patients in our experience.

**Study Design:** An observational study

**Place and Duration of Study:** This study was conducted at the Sheikh Khalifa Bin Zayyad Al Nahyan Medical Complex Quetta from January 2022 to January 2024.

**Methods:** These cases were graded using Tarek CDK Grading System from grade I – III. Treatment modalities included conservative management, minimally invasive techniques, and surgical interventions, depending on CDK severity. The clinical findings included assessment of range of motion (ROM), knee flexion and the occurrence of complications.

**Results:** Conservative management turned out to be most practical and effective approach with a success rate approaching nearly 95% in paediatric patients of grade I and 85% grade II. The minimally invasive techniques in grade III CDK showed a success rate of 70% in less than three months of age. Meanwhile, older age and patients unresponsive to conservative management had to complete surgical interventions including V-Y Quadricepsplasty with 63% success rate towards CDK grade III. ROM and knee flexion both significantly improved with averages of 76% and 80% respectively adding to the improvement in functional outcomes.

**Conclusion:** Early diagnosis and severity-based treatment improve CDK outcomes. Non-invasive methods work for early cases, while surgery is crucial for severe cases. Further research is needed to refine surgical techniques and develop innovative treatments.

**Key Words:** Joint, Tibiofemoral, Congenital Abnormality, Orthopedic Surgical Procedure, Congenital dislocation of knee

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## INTRODUCTION

Congenital dislocation of the knee (Genu Recurvatum Congenitum) is rare, occurring in 1 out of 100,000 births<sup>[1]</sup>. It involves knee hyperextension beyond 0° with limited or no flexion and may occur alone or with conditions like Ehlers-Danlos, Arthrogyrosis, and Marfan's Syndrome<sup>[1,2]</sup>.

CDK is commonly diagnosed at birth but can be detected earlier through antenatal ultrasonography, which provides a clear and safe view of the lesion.

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Ultrasonographic diagnosis is faster and cheaper than other radiological methods, both perinatally and post-correction<sup>[3]</sup>. It can be unilateral or bilateral, with a higher prevalence in females, and its causes may be extrinsic (e.g., maternal trauma) or intrinsic (e.g., genetic abnormalities and developmental deficiencies)<sup>[4,5]</sup>.

The Tarek CDK Grading System, introduced by Tarek Abdelaziz and Samir in 2011, modified the classification by Leveuf and Pais from 1946<sup>[6]</sup>. It assesses disease severity based on passive knee flexion, analyzed radiographically. The system classifies cases into three stages: GI (recurvatum with >90° passive flexion), GII (subluxation/dislocation with 30–90° passive flexion), and GIII (dislocation with <30° passive flexion). While GIII requires invasive surgery, GI and GII can be managed conservatively or with minimally invasive techniques<sup>[3,6]</sup>.

Newborns and infants up to 3 months are managed conservatively with serial manipulation, casting, and a Pavlik harness once 90° flexion is achieved for proper alignment<sup>[6]</sup>. Early intervention leads to better functional outcomes<sup>[3]</sup>. Children over 6 months or those

failing conservative treatment require surgery<sup>[2]</sup>. Minimally invasive techniques like Percutaneous Quadriceps Recession (PQR), Percutaneous Quadriceps Needle Tenotomy (PCQNT), and Mini Open Quadriceps Tenotomy (MOQT) have shown satisfactory results in infants under 3 months<sup>[7]</sup>.

V-Y Quadricepsplasty (VYQ), introduced by Curtis and Fisher in 1969, is widely used for GIII CDK and failed GI and GII cases<sup>[6]</sup>. It involves an anterolateral approach with V-Y advancement to address quadriceps extensor pathology, the primary issue in most CDK cases<sup>[6]</sup>. Femoral shortening, preferred in CDK with CDH, minimizes quadriceps damage, and both techniques show similar satisfactory outcomes<sup>[6,8,9]</sup>.

The pathology should be corrected before the child starts walking to prevent femoral condyle curvature loss and poor surgical outcomes<sup>[10]</sup>. Treatment can begin at birth or within the first few days<sup>[11]</sup>, though some authors suggest waiting a month for potential spontaneous reduction in isolated CDK cases<sup>[7]</sup>.

**METHODS**

This observational study was conducted at Sheikh Khalifa bin Zayyad Al Nahyan Medical Complex, Quetta from January 2022 up to January 2024. The purpose was to assess the clinical outcomes of management modalities followed for congenital knee dislocation (CDK) at our institute. Retrospective data collection methods such as medical records review and prospective data collection methods such as follow up of children diagnosed with CDK were utilized.

The study included 46 pediatric patients diagnosed with CDK at birth or early infancy using ultrasonography or clinical examination. The Tarek CDK Grading System assessed disease severity.

Patients with unilateral or bilateral CDK diagnosed at birth or early infancy, who followed conservative management, minimally invasive techniques, or surgical management based on the severity according to Tarek CDK Grading System, were included in the study. Patients with incomplete medical records and additional congenital lower-limb deformities that could influence treatment outcomes, were excluded from the study.

CDK severity was classified according to Tarek CDK Grading System: Grade I (simple recurvatum with >90° passive knee flexion), Grade II (subluxated or dislocated with 30° to 90° of passive knee flexion), and Grade III (dislocated with <30° passive knee flexion). Grades I and II were managed mainly conservatively, while Grade III cases were surgically managed if conservative treatment failed.

Treatment approaches included conservative management through manipulation and casting, followed by a Pavlik harness for infants once 90° of knee flexion was achieved. For minimally invasive techniques, Percutaneous Quadriceps Recession (PQR),

Percutaneous Quadriceps Needle Tenotomy (PCQNT), and Mini Open Quadriceps Tenotomy (MOQT) were used for patients with Grade I, II, or early Grade III CDK. Surgical interventions such as V-Y Quadricepsplasty (VYQ) and femoral shortening were reserved for Grade III cases or those unresponsive to conservative treatment.

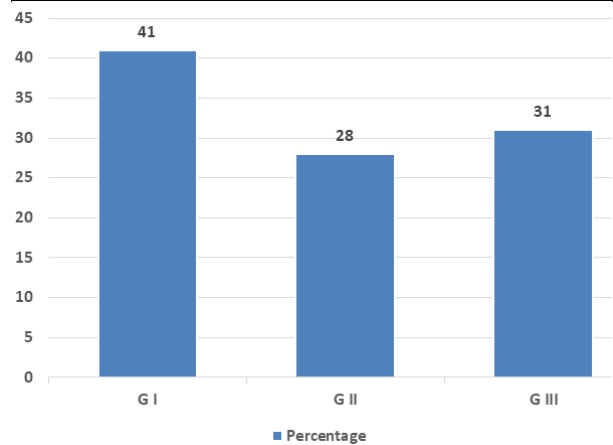
Outcome measures included ROM, functional scores, complications, recurrence rates, and patient satisfaction via caregiver surveys. Data were analyzed using medical records, chi-square tests for categorical data, and t-tests for continuous data, with significance set at  $p < 0.05$ .

**RESULTS**

The study analysed 46 patients with congenital knee dislocation (CDK), with a gender distribution of 59% male and 41% female. The mean age at diagnosis was 18 months, ranging from 1 to 36 months. Clinical severity was classified into three grades, with 41% of cases being Grade I, 28% Grade II, and 31% Grade III.

**Table No. 1: Baseline Characteristics of Patients with Congenital Knee Dislocation (CDK)**

Characteristic		Details
Total Sample Size		46
Gender Distribution	Male	27 (59%)
	Female	19 (41%)
Mean Age at Diagnosis		18 months (range: 1–36 months)
Unilateral Cases		29 (63%)
Bilateral Cases		17 (37%)
Family History of CDK		1 (24%)



**Figure No. 1: Tarek CDK Grading System and Distribution of Cases**

Grade	Description	Patients	%
GI	Simple recurvatum with >90° passive flexion	19	41%
GII	Subluxation or dislocation with passive flexion 30°-90°	13	28%
GIII	Dislocation with <30° passive flexion	14	31%

**Table No. 2: Treatment Approaches and Outcomes by Age Group and Severity**

Age Group	Grade	Treatment	Techniques	Success Rate
New born to 3 months	GI	Conservative	Serial manipulation, casting	95%
	GII	Conservative	Pavlik harness	85%
	GIII	Minimally invasive	PQR, PCQNT, MOQT	70%
3-6 months	GI	Conservative or minimally invasive	Casting, Pavlik harness	90%
	GII	Minimally invasive	PQR, PCQNT, MOQT	75%
	GIII	Surgical	V-Y Quadricepsplasty	63%
Over 6 months	GIII	Surgical	V-Y Quadricepsplasty, femoral shortening	57%

PQR: Percutaneous Quadriceps Recession  
 PCQNT: Percutaneous Quadriceps Needle Tenotomy  
 MOQT: Mini Open Quadriceps Tenotomy

**Table No. 3: Functional Outcomes and Follow-Up Results**

Outcome Measure	Baseline Score	Follow-Up Score	Improvement (%)
Range of Motion (ROM)	22–38 deg	92–120 deg	76%
Knee Flexion	29 deg	109deg	80%
Pain Score (VAS)	6/10	1/10	86%

**DISCUSSION**

The study emphasizes early diagnosis and stratified management for CDK, confirming previous research. Grade I and II cases had success rates of 95% and 85% with conservative treatment, aligning with Abdelaziz et al.<sup>[3]</sup>, who highlighted the benefits of early serial casting and Pavlik harness use. Evidence also shows that early intervention achieves over 80% success, while delayed treatment lowers efficacy and increases complications<sup>[3,13]</sup>.

In severe Grade III cases, minimally invasive techniques such as percutaneous quadriceps recession (PQR) and mini-open quadriceps tenotomy (MOQT) reached a 70% success rate in patients under three months. These data are consistent with Shah et al.<sup>[12]</sup>, which concluded that less invasive techniques can decrease surgical morbidity with satisfactory correction of severe cases of CDK. However, Grade III cases more than six months old had poorer results with surgical procedures, including V-Y quadricepsplasty and femoral shortening, being successful at a rate of 57%. Recent studies have highlighted the need to combine femoral shortening with capsulorrhaphy in an effort to produce better outcomes and reduce complications, including quadriceps weakness and postoperative stiffness<sup>[3,14]</sup>.

Functional improvement is impressive, with an 80% improvement in knee flexion and a 76% improvement in range of motion (ROM) following treatment. Studies

show early conservative or minimally invasive interventions have also been associated with functional mobility gains<sup>[3,6,13,14]</sup>. In addition, pain scores dropped significantly, supporting evidence that early correction improves long-term comfort and reduces osteoarthritis risk.

The study further emphasizes the importance of ultrasonography in the identification of early CDK. During the perinatal period, CDK can be diagnosed non-invasively and in an economical manner using ultrasonography, providing an early possibility for intervention [15]. Recent literature evidences its help to differentiate CDK from other limb deformities, guiding treatment<sup>[15,16]</sup>.

The study's treatment protocols had minor complications like mild misalignment and skin irritation. However, these were fewer than those seen in cases of delayed or insufficient CDK treatment. B K AR et al.<sup>[2]</sup> reported higher complication rates, including joint instability and recurrent dislocation, when treatment began after six months.

The study's low recurrence rates confirm the effectiveness of the stratified treatment approach. Abdelaziz et al.<sup>[3]</sup> similarly reported recurrence rates below 10% for conservative and minimally invasive treatments. Research by Lin et al. (2023) emphasizes individualized treatment based on severity and age to further reduce recurrence and morbidity.

Another classification categorizes CDK based on the anatomical relationship of the distal femur and proximal tibia<sup>[17]</sup>. Another system defines three types by reducibility and stability: Type I (easily reducible, flexion stable), Type II (unstable but reducible), and Type III (irreducible)<sup>[18]</sup>. This classification was used in a follow-up study comparing treatment outcomes<sup>[19]</sup>.

CDK not only affects the distal femur and proximal tibia, but it also has proneness to additional malformations affecting the upper extremities, face, digestive tract and reproductive system<sup>[17]</sup>. CDK might also be an indicator for congenital hip dislocation, which can be detected with associated congenital neuromuscular disabilities<sup>[20]</sup>. Congenital hip dislocation and other musculoskeletal abnormalities are reported in 82-88% of CDK cases<sup>[21]</sup>.

Early diagnosis and treatment of CDK at birth are crucial to prevent lifelong disability. A 2-year-old girl with neglected bilateral CDK had failed serial casting at birth and presented with -90° knee hyperextension, requiring VYQ surgery with tendon transfers, showing satisfactory results at six months<sup>[22]</sup>. Another case involved a 12-year-old boy untreated for 5–6 years, initially undergoing bilateral supracondylar femoral osteotomy but remaining unable to walk until a three-stage treatment at age 12, leading to stable knees at a 2.5-year follow-up<sup>[23]</sup>. These cases highlight the importance of timely intervention for better long-term outcomes.

Such cases highlight the importance of early diagnosis and treatment. Conservative treatments should begin immediately upon recognition of pathology in the initial stage of life<sup>[21]</sup>, followed up with surgeries to be performed when needed, and ideally must be performed within 15 months of life and not later than 2 years<sup>[12,24]</sup>.

The study highlights that early diagnosis and stratified interventions significantly improve CDK outcomes with low complication rates. It emphasizes the need for advancements in diagnostic imaging and minimally invasive techniques to enhance patient care.

## CONCLUSION

This study demonstrates the effectiveness of age-appropriate and severity-based management strategies for CDK. Early diagnosis and intervention remain critical for achieving optimal functional outcomes and minimizing complications. Further research is needed to refine surgical techniques and explore innovative approaches for managing severe cases.

**Implications:** Early diagnosis allows effective conservative treatment for Grades I and II, while severe Grade III cases should attempt conservative management before surgery to optimize outcomes.

**Limitations:** The study's limitations include a single-center sample and lack of long-term follow-up, highlighting the need for multi-center research with extended follow-up to assess long-term treatment outcomes.

**Ethical Considerations:** The study adhered to ethical requirements and was approved by the institutional review board of Sheikh Khalifa bin Zayyad Al Nahyan Medical Complex. Parents or guardians of all the children who participated provided informed consent before the study

### Author's Contribution:

Concept & Design or acquisition of analysis or interpretation of data:	Mohammad Aslam Mengal, Saddam Mazar
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Final Approval of version:	All the above authors
Agreement to accountable for all aspects of work:	All the above authors

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