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***Research paper***

# Staged Correction of Bilateral Genu Valgum in An Adolescent A Girl Using A Distal Femoral Osteotomy Using A DCP Plate and PHILOS Plate: A Case Report

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**Abstract**

Genu valgum is a coronal plane deformity commonly encountered in adolescents. If left uncorrected, it can lead to functional disability, abnormal gait mechanics, patellofemoral instability, and early osteoarthritis. While mild deformities may resolve with growth, significant or persistent valgus alignment often requires surgical correction. We present the case of a 13-year-old girl who underwent staged bilateral distal femoral varus osteotomies for correction of idiopathic genu valgum. The right limb was operated on in September 2023 using a Dynamic Compression Plate (DCP), and the left limb in April 2024 using a Proximal Humerus Internal Locking System (PHILOS) plate. The case highlights the effectiveness of the PHILOS plate for distal femoral osteotomy fixation in pediatric patients, emphasizing its mechanical advantages and clinical benefits compared to conventional plating systems.

***Keywords***: *Bilateral Genu Valgum; Deformity Correction; PHILOS Plate; Corrective Osteotomy.*

## 1. Introduction

Genu valgum, commonly known as knock-knees, is considered a physiologic condition in early childhood but may persist or worsen during adolescence in certain individuals. When the deformity is severe, progressive, or symptomatic, surgical intervention becomes necessary. In adolescents with skeletal immaturity and open growth plates, distal femoral varus osteotomy is a widely accepted surgical approach for correction, especially when the apex of the deformity lies within the distal femur (Klein, n.d.).

The method of fixation plays a critical role in the success of the osteotomy. Traditionally, non-locking plates like the Dynamic Compression Plate (DCP) have been used for internal fixation. However, these plates may not conform ideally to the anatomical geometry of the adolescent femur, particularly at the metaphyseal level. Moreover, in pediatric bone with thinner cortices, achieving stable fixation with conventional screws can be challenging (Paley, 2002). In contrast, locking plate systems provide angular stability and better fixation in cancellous or metaphyseal bone (Miller & Gordon, 2016). The PHILOS plate, although originally designed for proximal humeral fractures, has emerged as a versatile implant in orthopedic surgery, with off-label use in various long bones, including the femur (Krettek, n.d.). Its low-profile design, multiple locking screw options, and anatomical contour make it a promising alternative for deformity correction in growing children.

## 2. Case Report

A 13-year-old girl presented to our outpatient department in August 2023 with complaints of progressive deformity in both knees over the past two years. She reported discomfort during running, squatting, and long-distance walking, and expressed concern about the cosmetic appearance of her legs. There was no history of trauma, infection, or systemic illness. Gait examination revealed valgus thrust during the stance phase without instability. Range of motion in both knees was full and painless.

Radiological evaluation included standing long-leg anteroposterior radiographs, which showed anatomical axis deviation of 12° valgus on the right and 11° on the left. (Fig. 1) The medial proximal tibial angle and joint congruency were normal. Physeal plates were open, indicating ongoing skeletal growth. A diagnosis of idiopathic bilateral genu valgum with femoral origin was made, and surgical correction was planned in two stages.

The right limb was addressed first in September 2023. A lateral distal femoral closed wedge varus osteotomy was performed. Fixation was achieved using a 3.5 mm narrow DCP plate with conventional cortical screws. The surgery was uneventful, and postoperative radiographs confirmed satisfactory alignment. Rehabilitation began with knee mobilization at two weeks and partial weight-bearing at four weeks.

Radiological union was observed at 10 weeks, and the patient regained full, pain-free motion by three months. However, she experienced mild discomfort over the lateral distal femur due to the bulkiness of the implant.

**Fig. 1:** 13-Year-Old Presented with Complaint of Knee Deformity. Standing Long-Leg Radiograph Showing Bilateral Genu Valgum with Anatomical Axis Deviation of 12° Valgus on the Right and 11° on the Left.

The left side was operated on in April 2024. Intraoperatively, the lateral metaphyseal bone was found to be narrower than the contralateral side. Given the limitations observed with the DCP plate, a 3.5 mm PHILOS plate was selected for fixation. The PHILOS plate offered multiple advantages: its locking screw construct provided angular stability; the anatomical curvature matched the lateral femoral contour; and the low-profile design minimized soft tissue irritation. Osteotomy was fixed using locking screws proximally and distally, and stable fixation was achieved. Postoperatively, mobilization protocols were similar, but due to the enhanced fixation, the patient began full weight-bearing two weeks earlier than in the first surgery. Radiological union was confirmed at nine weeks, and there were no signs of implant irritation, infection, or hardware failure.

At the 1.5-year follow-up in July 2025, the patient demonstrated excellent functional and radiological outcomes. (Fig. 2) The mechanical axis had been restored to neutral bilaterally, and the range of motion in both knees was complete and symmetrical. (Fig. 3) The Knee Injury and Osteoarthritis Outcome Score (KOOS) had improved from a preoperative score of 55 to 92 on the right and 96 on the left. Notably, the patient reported greater comfort on the left side, which had been fixed with the PHILOS plate, and no hardware-related symptoms were present.

**Table 1:** Preoperative and Postoperative Outcomes

| Parameter | Right Limb (DCP) | Left Limb (PHILOS) |
|---|---|---|
| Pre-op KOOS score | 55 | 55 |
| Post-op KOOS score | 92 | 96 |
| Time to union | 10 weeks | 9 weeks |
| Partial weight-bearing | 4 weeks | 2 weeks |
| Full weight-bearing | 8 weeks | 6 weeks |
| Implant-related discomfort | None | None |

**Fig. 2:** Radiograph at 1.5-Year Follow-Up After Second Surgery Showing Maintained Correction, Restoration of Neutral Mechanical Axis, and Radiographic Evidence of Union at Both Osteotomy Sites.

**Fig. 3:** Clinical Photograph at 1.5-Year Follow-Up After Second Surgery Demonstrating Symmetrical Lower Limb Alignment and Restoration of Normal Coronal Plane Axis.

## 3. Discussion

Distal femoral varus osteotomy remains the gold standard for correction of valgus deformity originating from the femur(Paley, 2002). The stability of the fixation construct is essential for maintaining correction, achieving bone union, and permitting early rehabilitation. Traditional non-locking plates like the DCP rely on precise plate-to-bone contact and screw purchase for stability. In pediatric patients, especially in the
metaphyseal region with less dense cortical bone, this fixation may be suboptimal and can lead to hardware prominence or loss of correction (Krettek, n.d.; Miller & Gordon, 2016).

Locking plate systems have revolutionized internal fixation, especially in metaphyseal regions. The PHILOS plate, although designed for the proximal humerus, offers several features that make it suitable for distal femoral osteotomy in adolescents. Its low-profile design reduces the risk of implant irritation, which is particularly beneficial in thin, young patients. The precontoured shape of the plate closely matches the curvature of the lateral distal femur, minimizing the need for intraoperative plate bending. The locking screw mechanism provides a fixed-angle construct that maintains angular stability across the osteotomy site, even in soft pediatric bone. Additionally, the multidirectional locking options help in optimizing screw trajectory while avoiding open growth plates(Klein, n.d.).

The advantages of locking plates have also been substantiated by biomechanical studies. Krettek et al. (2001) demonstrated that locking constructs provide superior angular stability and load-sharing capacity compared to conventional plates, especially in metaphyseal and osteoporotic bone. These findings support the mechanical rationale for employing the PHILOS plate in pediatric femoral osteotomy, where bone quality and cortical thickness are often limiting factors for conventional fixation.

Our case demonstrates the superiority of the PHILOS plate in terms of patient comfort, implant stability, and early functional recovery. While the DCP plate achieved satisfactory correction and union, the implant bulk and lack of angular stability posed minor limitations. The PHILOS plate, in contrast, allowed earlier weight-bearing, less postoperative discomfort, and equally reliable union. These findings align with recent literature, including studies by Eidelman et al. and Klein et al., which reported favorable outcomes using PHILOS and other locking plates in pediatric deformity correction (Eidelman et al., 2006; Klein, n.d.). Klein et al. (2009), in particular, highlighted consistent correction, stable fixation, and minimal complications when locked plates were used in children with genu valgum, further supporting the outcomes observed in our patient.

Although our case reported no complications, potential concerns with the off-label use of PHILOS plates in pediatric patients warrant attention. These include risks of physeal injury if screws are misdirected, implant prominence or irritation in thinner individuals, and rare occurrences of screw loosening or hardware failure. Studies evaluating pediatric locking plate fixation have noted such complications, albeit infrequently, underscoring the importance of careful surgical planning and patient selection.

Further research should focus on long-term follow-up of children treated with PHILOS plates for distal femoral osteotomy. Comparative studies assessing PHILOS versus other locking systems, as well as prospective multicenter cohorts, would provide higher-level evidence regarding durability, functional outcomes, and growth-related effects. Such data could ultimately inform surgical guidelines and help refine implant selection for pediatric deformity correction.

## 4. Conclusion

The staged correction of bilateral genu valgum in this adolescent girl using distal femoral osteotomy demonstrates the successful use of both conventional and locking plate systems. The PHILOS plate, though originally intended for proximal humeral fractures, proved to be a safe, stable, and effective fixation method for distal femoral osteotomy in pediatric patients. Its anatomical design, locking construct, and low profile offer mechanical and clinical advantages that make it a strong candidate for deformity correction surgeries in growing children. Based on this experience, the PHILOS plate may be considered a superior alternative to traditional fixation in selected cases of adolescent genu valgum.

## Conflict of Interest

The authors declare that there are no conflicts of interest related to this publication.

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## Authors' Contributions

SPG conceptualized the study, carried out the research, and provided the necessary materials. RMS was involved in data acquisition and organization. USD performed data analysis and interpretation. SSU drafted the manuscript and coordinated logistical aspects. All authors reviewed and approved the final version of the manuscript and accept full responsibility for its content and integrity.

## Use of Artificial Intelligence

Artificial intelligence was employed in a limited capacity solely for grammar enhancement and formatting purposes. All scientific interpretations and clinical conclusions were independently formulated and verified by the authors.

## Ethical Approval

This case report was conducted in alignment with the ethical principles of the Declaration of Helsinki. Ethical approval from the institutional committee was not required as this report pertains to a single patient case.

## Patient Consent

Written informed consent was obtained from the patient for the publication of clinical data and associated images. Patient confidentiality has been maintained by ensuring that no personally identifiable information is disclosed.

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