Journal of Surgery and Surgical Specialities,
Volume 1, Issue 2, June 2025; pp: 57-62
eISSN: 2455-2860 DOI: 10.65129/surgical.v1i2.16

ORIGINAL ARTICLE

Guided Growth-Deformity Correction in Genu Valgum – Our Experience

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Abstract

Adolescent Genu Valgum, characterised by progressive knee valgus deformity, can significantly impair functional mobility and quality of life. This case study explores a personalised surgical approach—using corrective osteotomy and hemiepiphysiodesis—for the effective management of bilateral genu valgum, demonstrating correction tailored to the severity of the deformity. **Introduction**: Adolescent genu valgum, caused by idiopathic or growth-related factors, often leads to gait disturbance, knee pain, and early arthritis, requiring timely surgical correction. Accurate identification of the deformity site is essential for proper management. In this study, hemiepiphysiodesis was used for gradual correction in growing adolescents, while corrective osteotomy was performed for severe or fixed deformities. **Materials and Methods**: This prospective study was conducted in the Department of Orthopaedics, Government Stanley Medical College, Chennai, from 2022 to 2024. Three adolescents with progressive bilateral genu valgum and walking difficulty were included. Patients with prior lower-limb surgery or neuromuscular disorders were excluded. Clinical examination and full-length standing radiographs of both lower limbs were performed, and deformity was assessed using the lateral distal femoral angle (LDFA). Postoperatively, range of motion exercises began on day two. Patients treated with hemiepiphysiodesis were allowed early weight-bearing, whereas those who underwent osteotomy progressed to full weight-bearing only after radiological union, usually by 10-12 weeks. All patients were followed up for one year, and correction was assessed both clinically and radiologically. **Results**: All three patients showed significant improvement in knee alignment following surgical intervention. Preoperative LFDA ranged from 72° to 82°, and postoperative LFDA improved to 85°–88°, within the normal range of approximately 85°. One patient achieved correction with hemiepiphysiodesis alone, while one patient with severe deformity and another with residual deformity required additional neutral wedge translational distal femoral osteotomy. Overall, all patients demonstrated successful correction of valgus deformity and restoration of normal knee alignment. **Conclusion**: Hemiepiphysiodesis is effective in skeletally immature patients with mild to moderate genu valgum, whereas corrective osteotomy is preferred for severe deformities, residual deformity following hemiepiphysiodesis, or in skeletally mature patients. Both methods achieved satisfactory functional and radiological outcomes, underscoring the importance of selecting the appropriate procedure based on patient age and deformity severity.

Keywords: Adolescent Genu Valgum, Corrective Osteotomy, Distal Femoral Osteotomy, Hemiepiphysiodesis

1. Introduction

Genu valgum, or "knocked knees", are part of the coronal plane deformities of the lower extremity. The majority of patients are asymptomatic and have no functional limitations. This condition can be preceded by flat feet and occasional medial foot and knee pain. Children start developing physiologic genu valgum starting by age 2, and it becomes most prominent between ages 3 to 4. After that, it typically decreases to a stable, slightly valgus position by age 7 years. Intermalleolar distance has been used to assess the degree of genu valgum. Rarely, in cases where valgus alignment continues to increase, it can be associated with an out-toed gait, lateral subluxation of the patella, and rubbing of the knees together as the child ambulates.

Genu valgum can present as a bilateral or unilateral deformity. Bilateral genu valgum is commonly

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Article Received on: 10 Feb 2025 Revised on: 10 April 2025 Accepted on: 15 June 2025

physiologic in younger children but may also occur due to underlying conditions such as skeletal dysplasias, metabolic bone diseases, or lysosomal storage disorders. On the other hand, unilateral genu valgum is usually pathological and often results from post-traumatic changes, tumours, or infections affecting the growth plate.

According to Patel and Nelson[1], the treatment of genu valgum depends on whether the deformity is physiologic or pathologic. Physiologic cases usually correct on their own and only need observation. Pathologic cases require proper evaluation and timely treatment to avoid complications such as patellar instability, gait problems, and early osteoarthritis. In growing children, guided growth using hemiepiphysiodesis with plates, staples, or screws can be done. In severe or skeletally mature cases, corrective osteotomy of the distal femur or tibia is preferred. In selected patients, external fixators may be used when correction and limb lengthening are needed.

2. Aim and Objectives

1. To evaluate the correction of deformity by hemiepiphysiodesis in growing children.
2. To evaluate the role of distal femoral osteotomy in managing severe deformities and residual deformities following hemiepiphysiodesis.

3. Review of Literature

Zajonz *et al.*[2] reported that growth modulation by means of temporary hemiepiphysiodesis using eight-Plates to treat genu valgum is a gentle and effective procedure. Particularly in young patients with high growth potential and in risk groups such as obese patients, slight overcorrection is desirable due to the rebound phenomenon. In children with only low growth potential (older than 14 years), owing to the low correction potential, the indication should be strictly reviewed, and the possible failure of therapy should be discussed with the patient.

Stevens *et al.*[3] reported that guided growth using eight-Plates is a safe and predictable method for correcting coronal plane deformities in children. They emphasised the importance of early intervention while growth potential remains.

Burghardt and Herzenberg[4] reviewed guided growth techniques and concluded that temporary hemiepiphysiodesis is minimally invasive, reversible, and effective, but requires regular follow-up to avoid over- or under-correction.

Ballal *et al.*[5] reported that guided growth with eight-Plates is effective for correcting genu valgum and genu varum, with very low complication rates, but highlighted the risk of rebound deformity if implants are removed too early.

According to a study by Adrees *et al.*[6], distal femoral varus osteotomy is considered a reliable procedure for the treatment of valgus knee deformity. The study highlighted that greater correction of the tibiofemoral angle leads to improved correction of the congruence angle, thereby enhancing knee alignment and stability.

Schlewitz *et al.*[7] demonstrated that distal femoral osteotomy not only corrects valgus malalignment but also improves patellar stability and allows young active patients to return to sport, making it a reliable joint-preserving option.

Backstein *et al.*[8] evaluated distal femoral varus osteotomy and found reliable correction of valgus knees with significant improvement in pain and function, recommending it as a good option in young patients with symptomatic deformity.

4. Materials and Methods

A prospective observational study was conducted in the Department of Orthopaedics, Government Stanley Medical College, Chennai, from 2022 to 2024 to evaluate the management of adolescent genu valgum.

Study Population

Three patients presenting with progressive knee valgus deformity, causing difficulty in walking and functional limitations, were included in the study.

Inclusion Criteria

- Adolescent patients with progressive genu valgum
- Functional limitation in walking due to deformity.

Exclusion Criteria:

- Patients with previous lower limb surgery
- Genu valgum due to neuromuscular disorders

Initial Assessment

All patients underwent clinical examination and initial screening with bilateral lower limb full-length X-rays. The deformity was quantified using the Lateral Femoral–Distal Angle (LFDA).

The study patients were classified as follows:
Patient 1: 13-year-old male; LFDA – Right: 72°, Left: 81°
Patient 2: 14-year-old female; LFDA – Right: 74°, Left: 82°
Patient 3: 11-year-old male ; LFDA – Right: 82°, Left: 78°

Management

- Patient 1: Hemiepiphysiodesis was performed on the left side, and a neutral wedge osteotomy on the right side due to severe deformity.
- Patient 2: Hemiepiphysiodesis was performed on both sides.

Serial follow-up was conducted for one year. Alignment outcomes were assessed clinically and radiologically. The patient had residual deformity on the right side, which was subsequently corrected with a distal femoral neutral wedge translational osteotomy, resulting in normalisation of the valgus deformity. Correction of valgus deformity as assessed by LFDA

- Patient 3; Hemiepiphysiodesis was performed on both sides.

Measurement of LFDA

The Lateral Distal Femoral Angle (LDFA) is measured on a standing anteroposterior full-length radiograph of the lower limb. To measure this angle, the mechanical axis of the femur is first drawn by connecting two midpoints along the femoral shaft. Next, a line is drawn along the distal femoral joint surface, connecting the lowest points of the medial and lateral femoral condyles. The LDFA is then formed as the lateral angle between the femoral mechanical axis and the distal femoral joint line. A normal LDFA ranges between 85° and 90°. An LDFA less than 85° indicates valgus deformity, whereas an LDFA greater than 90° suggests varus deformity.

Surgical Technique

(i) Hemiepiphysiodesis (Guided Growth)

- o A small medial incision was made to expose the physis.
- o An extraperiosteal tension band plate (eight-Plate) was placed across the physis and fixed with epiphyseal and metaphyseal screws under fluoroscopic guidance.
- o Early mobilisation was encouraged. Serial radiographs were taken every few months to monitor correction.
- o Plates were removed once the mechanical axis reached neutral or slight valgus.

(ii) Distal Femoral Corrective Osteotomy

- o A lateral approach was used to perform a neutral wedge osteotomy at the predetermined level under fluoroscopic guidance.
- o The distal fragment was translated medially to restore the mechanical axis and provisionally fixed with Kirschner wires.
- o Definitive stabilisation was achieved using a distal femoral locking plate. Alignment was confirmed fluoroscopically.

- Postoperatively, early range of motion exercises were initiated on day two. Patients who underwent hemiepiphysiodesis were allowed full weight-bearing as tolerated, whereas those treated with osteotomy progressed to partial and then full weight-bearing only after radiological evidence of healing, usually around 10–12 weeks.

5. Results (Including Observations)

All three patients showed improvement in knee alignment following surgical intervention. Patient 1, a 13-year-old male with preoperative LFDA of 72° on the right and 81° on the left, underwent hemiepiphysiodesis on the left side and a neutral wedge osteotomy on the right side; postoperative LFDA improved to 85° on the right and 88° on the left, achieving normal alignment.

Patient 2, a 14-year-old female with preoperative LFDA of 74° on the right and 82° on the left, underwent hemiepiphysiodesis on both sides, but residual deformity on the right required a distal femoral neutral wedge translational osteotomy; postoperative LFDA was 85° on the right and 87° on the left, achieving normal alignment.

Patient 3, an 11-year-old with preoperative LFDA of 82° on the right and 78° on the left, underwent hemiepiphysiodesis on both sides, resulting in

Table 1. Preop postop LFDA angle

Patient	Age/ Sex	Side	Preoperative LFDA (°)	Procedure Performed	Postoperative LFDA (°)
1	13 / M	Right	72	Neutral wedge osteotomy	85
		Left	81	Hemiepiphysiodesis	88
2	14 / F	Right	74	Hemiepiphysiodesis + Distal femoral osteotomy	85
		Left	82	Hemiepiphysiodesis	87
3	11 / M	Right	82	Hemiepiphysiodesis	86
		Left	78	Hemiepiphysiodesis	85

postoperative LFDA of 86° on the right and 85° on the left, restoring normal alignment. Overall, preoperative LFDA ranged from 72° to 82°.

All patients achieved postoperative LFDA within the normal range of approximately 85°, demonstrating successful correction of valgus deformity.

All three patients showed significant improvement in knee alignment following surgical intervention. The preoperative and postoperative LFDA values, along with the procedures performed, are summarised in Table 1.

Discussion

In this prospective study, three skeletally immature adolescents presented with genu valgum deformity. Among them, two were males and one was female. Of the three, one patient with a severe deformity on the right side underwent distal femoral neutral wedge osteotomy, while the opposite side was managed with hemiepiphysiodesis. The other two patients underwent hemiepiphysiodesis using eight-plate fixation.

Of the three patients, two achieved gradual and satisfactory correction of the deformity over one year, demonstrated by improvement in the LDFA and reduction in intermalleolar distance, without major complications. Previous studies by Zajonz *et al.*[2] and Stevens[3] have reported that hemiepiphysiodesis is a gentle and effective method for gradual correction in skeletally immature patients. However, one patient did not achieve adequate correction within the expected follow-up period and subsequently required a secondary distal femoral osteotomy, highlighting the limitations of guided growth in certain cases, particularly when growth potential is limited or the deformity is more severe.

Boero *et al.* (2011) emphasised that the timing of intervention is critical, since delayed procedures often result in incomplete correction or persistence of deformity. In contrast, when the deformity is severe or the physis is nearing closure, distal femoral osteotomy provides a more predictable and immediate correction. Stevens (2007) also reported that hemiepiphysiodesis is associated with fewer complications, but incomplete correction or rebound deformity can occur if follow-up is not ad.

This study emphasises the importance of individualised surgical strategies. Distal femoral osteotomy is effective for severe deformities or residual deformities following hemiepiphysiodesis, providing immediate correction. In contrast, hemiepiphysiodesis is best suited for mild deformities, allowing gradual correction by utilising the patient's remaining growth potential. Combining these approaches enabled optimal outcomes, effectively balancing deformity severity with available growth potential.

The first patient (13/M) presented with right-sided genu valgum (LDFA = 72°) and underwent neutral wedge osteotomy with postoperative correction to 85°. The preoperative, immediate postoperative, and one-year follow-up radiographs are shown in Figures 1 and 2.

7. Summary and Conclusion

(i) Hemiepiphysiodesis is effective in skeletally immature patients with mild to moderate genu valgum.
(ii) Corrective osteotomy is preferred for severe deformities, residual deformities following hemiepiphysiodesis, or in skeletally mature patients.

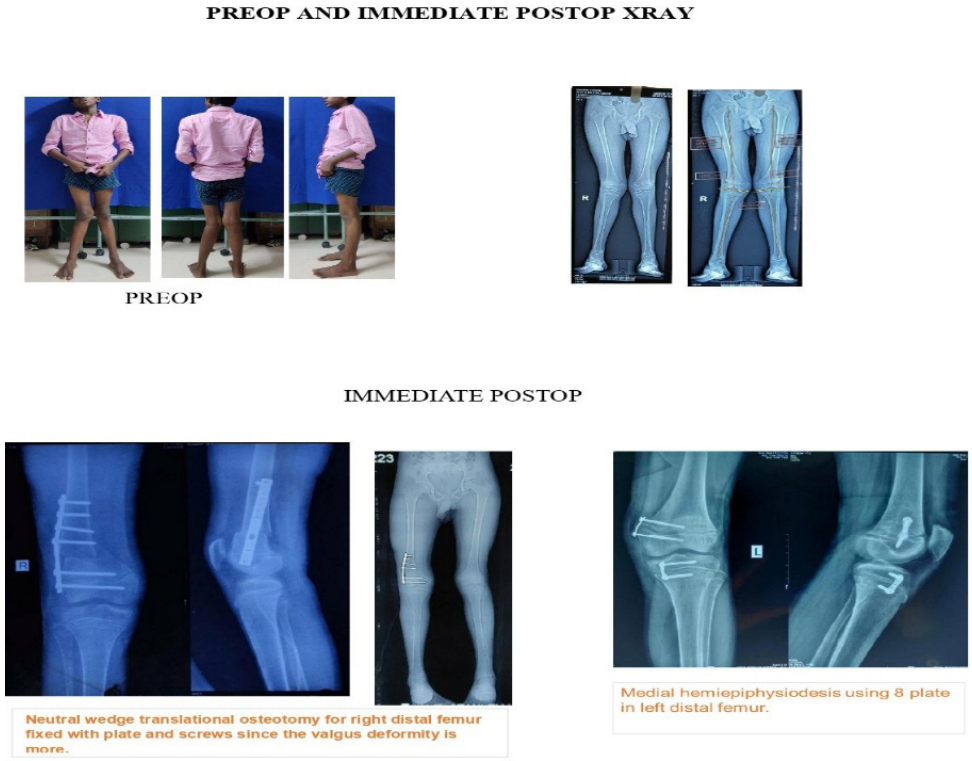

Figure 1. Figures pre-OP and immediate post-OP.

Figure 2. Follow-up X-ray.

(iii) Considering factors such as deformity severity and skeletal maturity in management can lead to satisfactory outcomes

8. References

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