Alq J Sci. 2026;2(6):543-549
https://doi.org/10.69667/ajs.26601
Alqalam Journal of Science
مجلـــة القلم للعلـوم
https://alqalam.utripoli.edu.ly/index.php/AR

Original article

Effectiveness of Medial Closing Wedge Osteotomy of the Distal Femur in the Management of *Genu Valgum*

Sanad Younes*, Ahmad Saad, Mohamed Edris

Orthopaedic Surgery Department, Faculty of Medicine, Omar Al-Mukhtar University, Libya
Corresponding email. sanad.younes@omu.edu.ly

Abstract
Genu valgum is a mechanical axis deviation lateral to the knee center that, when persistent in adolescents, leads to gait and functional disorders such as difficulty running, knee pain, patellar malalignment, lateral patellar instability, and ligamentous laxity. While physiologic valgus alignment is normal between two and seven years of age, chronic deformity beyond this period requires intervention. This prospective study was conducted at a private hospital (SISO) and a governmental hospital (UNAM) from May 2012 to April 2020, with a minimum follow-up of two years. Inclusion criteria were unilateral or bilateral genu valgum with tibiofemoral angle (TFA) >12° and intermalleolar distance (IMD) >10 cm in the standing position, in patients aged 14–18 years, without metabolic abnormalities. Thirty-four adolescents (56 knees) underwent closed wedge femoral osteotomy. Of these, 22 had bilateral deformity (64.7%), and 12 had unilateral (35.3%). The mean age was 15.6 ±1.3 years; 11 males (32.3%) and 23 females (67.7%). Presenting complaints included cosmetic deformity (67.6%), pain (11.8%), gait abnormalities (17.6%), and one case of a fall during walking. Postoperatively, IMD decreased significantly from 14.8 ±1.9 cm to 5.1 ±1.2 cm. TFA improved from 16.7 ±1.9° to 4.3 ±1.7° ($p<0.001$). Functional outcomes also improved, with mean Hospital for Special Surgery (HSS) scores rising to 84.2 points. Closed wedge femoral osteotomy, when performed with proper indication, meticulous preoperative planning, and stable internal fixation, provides reliable correction of adolescent genu valgum, enhances osteotomy stability, shortens partial weight-bearing duration, and accelerates recovery, making it an excellent option for treating valgus knee deformity.
Keywords. Medial Closing, Wedge, Osteotomy, Distal Femur.

Introduction

In genu valgum, this is a mechanical axis deviation lateral to the knee center. Chronic genu valgum in adolescents remains with the main gait and functional disorders (difficulties running, knee pain, and patellar malalignment, lip lateral stability, and laxity of ligament). Normal lower extremity valgus alignment between two and seven years of age [1,2]. 7 Years old and Correction of Excessive Physiologic Genu Valgum is required [3]. Nutritional rickets is the most common cause of these deformities in developing nations. The deformity either comes from the distal femur, proximal tibia, or the knee joint [4]. Genu valgum was sometimes found to originate at the distal femur with various angle measurements on standing radiographs of both lower limbs, including hips, knees, and ankles [5]. Be sure to cite characteristics of excessive genu valgum, such as high knee joint moments, with your answer [6].

Patients and Methods.

Data were collected at a private hospital (SISO) and governmental hospital (UNAM) in a prospective manner, from May 2012 to April 2020, with a minimum follow-up of two years for each patient. Patients fulfilling the criteria for inclusion were enrolled in our study. Our inclusion criteria were [1]. Unilateral/bilateral GV with tibiofemoral angle (TFA)>12° and intermalleolar distance (IMD) in the standing position>10cm. With ages ranging from 14 to 18 years [2]. Deformity mainly arose in the distal femur [3]. No active metabolic abnormality [4]. Agreement to participate in the study.

Patients were clinically examined in the outpatient department and then further evaluated radiologically and biochemically. Along with serum and urine calcium/phosphate, serum alkaline phosphatase, serum vitamin D3, and renal function test were done. Any metabolic derangement, if found, was corrected prior to definitive corrective intervention.

A standing anteroposterior radiograph of both hips, knees, and ankles was performed to measure the angles. Radiological TFA was measured by taking the angle between the anatomical axes of the femur and tibia. The lateral

Received*: 27-03-2026 -* ***Accepted****: 25-05-2026 -* ***Published****: 01-06-2026*

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distal femoral angle (LDFA) is calculated as the lateral angle between the mechanical axis of the femur and the articular surface of the distal femur (Figure 1. The medial proximal tibial angle was calculated as the angle between the tibial mechanical axis and the proximal tibia articular surface. We have also checked if there is any change in joint angles with respect to the horizontal axis.

The results were assessed both clinically (IMD and TFA) and radiologically (TFA and LDFA). The functional assessment was quantified by the Grading Summarised Hospital for Special Surgery Knee Score HSS). Subjective evaluation of parent satisfaction.

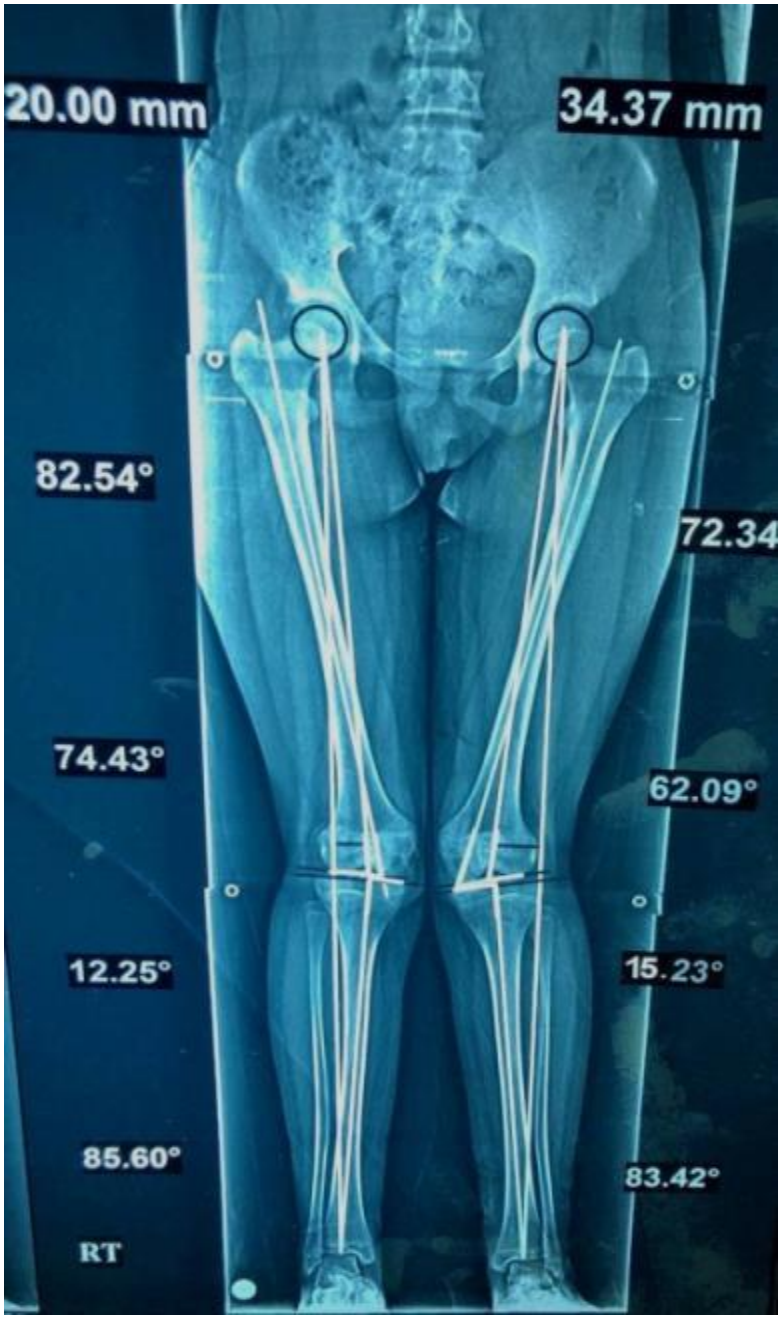

Figure 1: Standing full-length X-ray demonstrating the bilateral idiopathic valgus deformity.

Operative procedure

The surgery was performed in the supine position, using a high groin tourniquet. The ankle should be free, and utmost care was taken while draping. The ASIS mark was done using an electrocardiograph to check alignment

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during correction. Knee flexed and placed in a figure position. a medial longitudinal skin incision of size 6–8 cm long made from 1 cm distal to 5–7 cm proximal of the adductor tubercle in line with the femoral shaft (Figure 2). Dissection is carried through the superficial tissue until reaching the fascia of the vastus medialis, which in turn is incised along with the skin incision. Electrocautery is used to reflect the vastus medialis anteriorly from the intermuscular septum and expose the distal medial femur. Care should be taken to coagulate and/or ligate all the perforating vessels. The distal medial femur (A well-contoured locking femoral plate is used for fixing the osteotomy. Two K-wires placed from medial to lateral, along with the planned osteotomy angle, outline the proposed osteotomy (Figure. 3). by making multiple drill holes (the wedge osteotomy). An osteotome was used to connect the drill holes. A wedge of bone is then cut out. The 2 K-wires are removed.

Figure 2. Skin incision on the medial side.

Figure 3 2 K- wires to a planned osteotomy angle.

Closing the wedge must be performed gradually by gentle compression of the lower leg laterally, stabilizing the knee joint medially near the area of osteotomy. Crossed K-wires provide temporary stabilization of the osteotomy

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Electrocautary cable is used to assess the alignment of femoral head and mid-ankle (Figure 4), and the knee was examined to confirm if this line was passing through the centre of the knee or just lateral to the medial tibial spine. The osteotomy, once confirmed, was fixed internally.

Figure 4 Knee shows that this line was brought just lateral to the medial tibial spine.

An osteotomy was then stabilized with a locking screw. After that, compression across the osteotomy is achieved using a transosseous cortical screw through the first hole proximal to the osteotomy. The screw is introduced in a proximal-to-lateral direction, with the intention of optimizing compression across this osteotomy site; All remaining 3 holes are filled with locking screws. Plate positioning is subsequently confirmed with AP and lateral fluoroscopy (Figure 5).

A total of 56 limbs were treated by medial distal femur osteotomy, 42 were fixed by using locking plate and proximal tibial plate (T- plate) in 14 Iimb.

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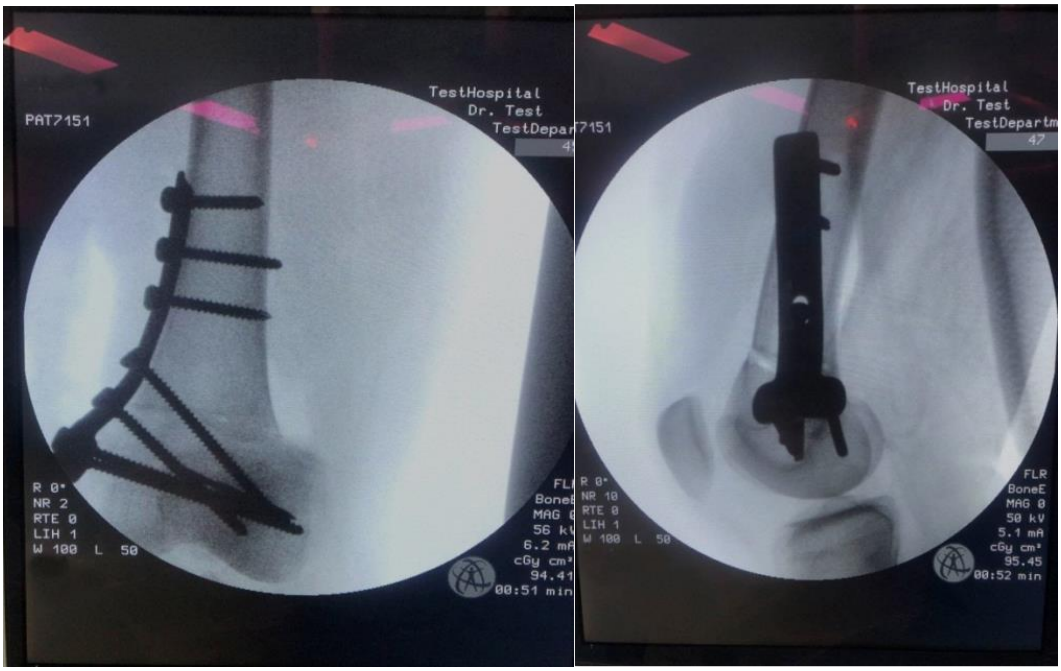

Figure 5 Plate position is verified with AP and lateral fluoroscopy (Photo of thesis).

Postoperative protocol.

500 mg of third-generation cephalosporin was delivered intravenously after 48 hours postoperatively, followed by oral antibiotics for 5 days in all patients. In the first 48 hours, an analgesic (intramuscular 75 mg of diclofenac sodium) was administered, and mild analgesics belonging to the NSAIDs class were used as needed for the next 5 days postoperatively. A dressing change was performed on the second day. The drain was removed at 24-48 hours postoperatively, and the collected blood was less than 50 cc. Wound status was monitored for the first 2 weeks, and stitches were removed.

Postoperative knee (AP and lateral) immediate radiographs were obtained. Methods: All patients were non-weight bearing for 3 weeks, followed by partial weight bearing with 2 crutches as tolerated. Cast removed after 6 weeks and, beginning with active assisted exercises. Full-weight bearing and higher-impact activities are allowed as muscle strength and symptoms permit. Patients were reviewed at 3 weekly intervals. Open in a separate window (Figure 3). Lateral radiograph of the hip at (a) 0 months, (b) and when the patient fails to maintain a stable condition, the subsequent AP radiographs can be performed every month for up to six months, then every 3 months for the next 6 months.

Results

Study Design: In this study, 34 subjects (56 knees) were identified as candidates for closed wedge femoral osteotomy for genu valgum deformity at the orthopedic department. Of the patients with bilateral genu valgum (22) and 12 limbs (64.7%), 12 had unilateral limbs (35.29%). Mean age (15.61±1.28) years; ranges:14 to 18 years. Sex distribution was 11 males (32.3 %), 23 females (67.6%) of the studied [9]. Out of the 34 patients, 23 presented with a chief complaint of cosmetic deformity, 4 had pain, and in 6, it manifested as gait abnormalities, while one patient gave a history of a fall while walking. The time of operation was 119.72±42.4 minutes (minimum 90 and maximum 140 minutes). Results: The average period of the study group was (8.9±1.7) weeks, ranging from 7 to 11 weeks, with most of the studied group occupying a healing time that ranged from 7 to 9 (88%). The average of IMD declines significantly from 14.77±1.95 to 5.11±1.23 Key findings. Results showed a statistically significant reduction in tibiofemoral angle (mean preoperative value of 16.67 ±1.92 degree to 4.26 ±1.7 degree postoperatively, P<0.001). HSS scores also statistically improved (increased), with mean 84,15 point post-operatively.

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Discussion

Coronal plane deformities, including genu valgum, are common presentations to the outpatient clinic in the orthopedic department, especially among adolescent females and young adults. It is well established that malalignment in the coronal plane increases the risk of subsequent development and progression of osteoarthritis [7]. A severe valgus deformity should be treated surgically to correct the biomechanical derangement, hence improving appearance, gait, and function [8].

The average age of patients studied was 15.61±1.28 with a minimum of 14 years and a maximum of 18 years, sex was: 11 male (32.3 %), 23 female (67.6%). Compatible with the study of Dhar et al. (2009). In the current study, the mean operation time was 119.72±42.4 minutes (range 90–140 min). This was like the average time of study of Vander Woude et al. (2016) [9]. Described 23 patients treated with medial closing wedge osteotomy at the distal femur for grade III to IV Articular Cartilage Damage and valgus knee alignment. An internal plate fixator was used to stabilize the osteotomy. The age ranged from 25 to 50 years. The average operative time was 89 min (range: 70–135 mins).

The mean of duration of after surgery for the current study was (8.9±1.7) weeks(range, 7-11 weeks), 16 patients (46.8%) had an shorter time of or equal with 9 weeks; while has same age group had union time>than 9 weeks as follows; This is consistent with Prakash et al. (2017) [10], who filed reports for 75, ages ranging from 12 to 18 which separated results into groups depending on the age level. 9.8 weeks, 10.5 weeks, and 12.1 weeks for 12-14 years union time, 14-16 years with union time, and so on from 16-18 years respectively [4]. However, in contrast to our findings, the study by Vander Woude et al. (2016) [9] noted that all patients achieved a bone union at 12 weeks. A period near the average of our study range.

The current study showed that the mean tibiofemoral angle was 16.8 ° (range, 12 ° to 19 °) before surgery, which improved to a mean postoperative value of 5.3 ° (range, 0° to 10°). Agreed with the results of Gupta et al (2014) [11]. The study included 30 adolescent or young adults presenting with a genu valgum deformity, and reported the mean tibiofemoral angle was 22.2 ° (range, 16°to 29°), which improved to a mean postoperative value of 5.1°(range, 0° to 10 °). Jaiman et al. (2020) [12]. A total of 30 patients. The mean age of the patients was 17.4 years (range, 13–23 years). The mean preoperative clinical TFA was 23.4° (range, 18°–28°), which improved after surgery to a mean postoperative value of 5.8° (range, 4°–7°). These two studies were similar to our results. Preoperative tibiofemoral angle is a prognostic factor that significantly affected our results. Most of the excellent results were in those with a tibiofemoral angle of less than 20°.

The mean mechanical Lateral distal femoral angle (mLDFA) was 77° range (73°-83°) preoperatively and corrected to our range (87°-90°). This was closely matched by Jaiman et al (2020) [12], who reported that the mean preoperative LDFA was 77.3° (range, 72°–81°).

The current study showed that the mean preoperative intermalleolar distance was 14.7cm (range, 12-19cm) decrease significantly to 5.11cm (range, 2–6 cm). With little differences in the results compared to the study of Jaiman et al (2020), [12] that reported the preoperative IMD was 13.5 cm (range, 13–21cm), which improved to a mean postoperative value of 2.3 cm (range, 1–5 cm). Ranjan et al (2019) [13] recorded the mean preoperative IMD was 17.3cm (range 12–24cm), which improved significantly after treatment to an average value of 3.9 cm (range 2–7 cm). Both these studies had similar results to the current study.

Regarding clinical results, which were assessed in the current study by the hospital for special surgery (HSS) scoring system. The HSS score for these patients improved to a mean of 62 points preoperatively. This score increased to a mean of 84 points postoperatively. More than half of the studied groups 34 limbs (61%) had excellent clinical results, 21 limbs (37%) had good clinical results, and 1 limb (2%) had fair clinical results. This is incompatible with the study of Stähelinm et al (2000), [14] Patients with 21 knees improved in average HSS score from 65 points preoperatively to 84 points. Results were rated as excellent in 11 knees, good in 8 knees, and fair in 2 knees.

Conclusion

Closed wedge osteotomy, when done for proper indication with thorough preoperative planning and by using stable internal fixation, could offer a satisfactory and more successful result than other methods used for operative correction of the genu valgum, where it enhances the stability of the osteotomy and permits a shorter period of partial weight bearing and faster recovery, making it an excellent option for the treatment of a valgus knee.

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Conflict of interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Received*: 27-03-2026 -* ***Accepted****: 25-05-2026 -* ***Published****: 01-06-2026*