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Original Research Article

Closing Wedge Distal Femoral Osteotomy for Genu Valgum Deformity in Infants and Adolescents with Internal Fixation by Using Wires

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Abstract:

Background and Objectives: K wires are infrequently used to treat distal femoral medial closure wedge osteotomy, one of the several techniques available for correcting genu valgum deformity. Here, we report on our experience correcting genu valgum abnormalities in children and adolescents with this very well-known osteotomy implant, which is not as commonly utilized.

Material and Methods: Individuals having a standing radiological tibio-femoral angle of less than 15° and an intermalleolar distance more than 10 cm, aged 8 to 15 years. A solitary Kirschner wire was used to stabilize the correction, which was made utilising the medial closure wedge osteotomy procedure. The Bostman et al. score was used to evaluate the functional result.

Results: Of the 27 limbs, 24 instances had a great outcome; two patients obtained a good functional outcome; while one patient obtained a knee score of less than 20.

Conclusion: For children and teenagers, genu valgum repair with distal femoral medial closure wedge osteotomy with fixation utilizing K wires is a feasible alternative.

Keywords: Closing wedge osteotomy; Genu valgum, K wire.

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Introduction

A frequent malformation that appears in late infancy is genu valgum. In underdeveloped nations, nutritional rickets is the primary cause of these abnormalities. Genu valgum typically starts from the distal femur, which may be validated by different angle measures on standing radiographs for both lower limbs, comprising hips, knees, and ankles [7,8,15].

The deformity may originate from the proximal tibia, the distal femur, or the knee joint. Surgical correction is required when the valgus deformity is severe [9].The literature has reported several forms of distal femur corrective osteotomies, including wedge-less "V" osteotomy, dome osteotomy, medial closing wedge, and lateral opening wedge. [2,5,13,16]

The alternatives outlined have drawbacks, including the possibility of knee stiffness, extended immobilization, and the use of large, expensive implants that violate a potentially viable physis plate.[2,5] With a closing-wedge osteotomy, bone grafting is not necessary. When fixing a medial closing wedge osteotomy in children or teenagers, locking plates typically impede physeal growth. However, when utilizing K wires to secure the closed wedge, a window is provided for further correction, if necessary. Furthermore, if extracted early enough, non-threaded K wires often do not impede physeal development and facilitate implant removal. [11]

Aim and Objectives:

Here, we report on our experience correcting genu valgum abnormalities in children and adolescents with this very well-known osteotomy implant, which is not as commonly utilized.

Material and Methods:

The study, which involved 15 patients between the ages of 8 and 15, was carried out prospectively at CIMS Chhindwara and a nearby district hospital. Out of the total 27 limbs, 12 had bilateral deformity and 3 unilateral. All of the patients were operated on in the CIMS Chhindwara orthopaedics department after being chosen from the outpatient paediatrics department based on the inclusion criteria. Patients with genu valgum deformity who had an intermalleolar distance of more than 10 cm and a tibio-femoral angle more than 15o were taken into consideration for study inclusion. Individuals with sagittal plane deformity (fixed flexion deformity or genu recurvatum) and unstable knee with evidence of subluxation were eliminated, as well as those with significant collateral ligament instability. Prior to surgery, patients with active underlying conditions received medical care. Patients had a distal femoral medial closed wedge osteotomy to address their deformity, which was then repaired with K wire. The deformity assessment was performed both radiologically and clinically [Figure 1a, 1b]. Clinically, standing with both patellas looking forward, the intermalleolar distance was measured. Affected limb standing anteroposterior and lateral radiographs, comprising the hip, knee, and ankle joint, were obtained [Figure 2]. The angle that forms between the tibia and femur's anatomical axes is known as the radiological tibio-femoral angle. The line traced from the centre of the femoral head to the middle of the ankle was designated as the mechanical axis of the lower limb. The mechanical axis deviation (MAD) was computed as the distance among the mechanical axis line and the knee's centre in the frontal plane. The angle between the distal femur's articular surface and mechanical axis was determined to be the lateral distal-femoral angle, or LDFA.

Figure 1(a): bilateral genu valgum deformity

Figure 1(b): unilateral genu valgum deformity

Figure 2: Standing full antero-posterior radiograph of both limbs

Surgical Technique:

The patient is placed supine on a radiolucent operating table underneath tourniquet control while the procedure is carried out under general or spinal anaesthesia. During the procedure, the knee is bent to 600 degrees to retain a huge bolster beneath it and prevent pressure in the popliteal region. Caution had been taken to expose the ankle during draping so that its centre may be quickly found.

An 8–10 cm long medial longitudinal skin incision is made, starting at the level of the medial joint line and finishing 5 cm above the adductor tubercle. To enable the proper wedge to be resected, Kirschner wires, often known as K-wires, are utilized to indicate the osteotomy cut both proximally and distally. To create the inferior wedge of the osteotomy, the first two wires are positioned anteriorly and posteriorly. To prevent angular mal-alignment, great care should be made to acquire an ideal antero-posterior fluoroscopic image of the distal femur. A second pair of wires is positioned in a convergent manner to establish the wedge's proximal margin once the required wedge size has been verified.

The two sets of wires' distances should match the computed wedge size. Under fluoroscopic supervision, the saw is utilized to make both medial-to-lateral incisions; initially, an oscillating saw is only used to execute the osteotomy on the medial cortex. A tiny osteotome is then used to finish the osteotomy. It helps thin the lateral cortex without causing unnecessary damage to the periosteum and lowers the risk of heat necrosis. The lateral cortex is lightly broken with a little valgus push. Following the osteotomy, the knee is extended, and a light manual varus force is used to rectify the deformity. To get the ultimate alignment of around 5 to 7 degrees of valgus, the leg's alignment is verified frequently in extension. After that, internal fixation using a single K wire oriented laterally stabilizes the osteotomy even more. [Figure 3] After the deformity has been corrected, the osteotomy's stability in flexion and extension is examined on the table. Hemostasis is reached and the tourniquet is loosened. The wound is bandaged and a vacuum drain is placed. After the sutures are removed, a high above knee slab is put from the groyne to the ankle to immobilize the knee joint for two weeks. An above knee cast is then worn for the remaining six weeks.

Post-operative care and follow up:

24 to 48 hours after surgery, the drain is removed, and two weeks later, the sutures are placed. After six weeks of not being able to carry any weight, the patients are allowed to use two crutches to help them bear some weight as tolerated. Active aided workouts begin when the cast is taken off. After eight to twelve weeks, the patient can bear their full weight. Patients had reviews every two weeks. Standing radiographs were obtained at 4-week intervals and in the immediate post-operative period, in both the AP and lateral views.

At each OPD visit, the patients' range of motion in the knee joint was assessed, together with clinical [Figure 4] and radiographic evaluations for the alignment and condition of the osteotomy union. Every patient received a prescription for calcium and vitamin D supplements. The functional result was evaluated using the knee score, as recommended by Bostman et al [3]. Patients were considered to have had a good result if their score fell between 28 and 30. A score of 20 to 27 was considered good, while a score of less than 20 was deemed inadequate.

Figure 3: Postoperative radiograph following ostotomy and K wire fixation

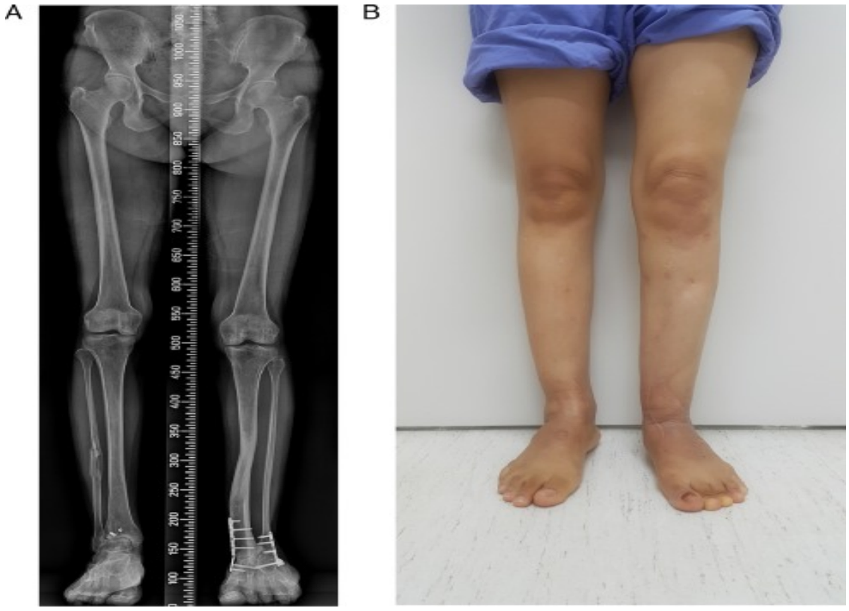

Figure 4: Clinical picture after correction of deformity

Statistical analysis: To ascertain if the outcomes were statistically significant, the difference in means for values obtained preoperatively and postoperatively was analysed using the student's paired t-test. A P value of less than 0.05 was deemed significant.

Results

15 patients—six of whom were male and nine of whom were female—had 27 limbs operated on. The patients in our research ranged in age from 8 to 15 years old, with an average age of 11 years. Three individuals were idiopathic, and twelve patients showed signs of nutritional rickets or osteomalacia. 100 ml was the average blood loss (range, 50 ml - 150 ml). The hospital stay lasted an average of five days (range: three to seven days). The follow-up duration was 14.8 months on average (range: 11 to 24 months). The inter-malleolar distance was 12.8 cm (range, 10 cm - 17 cm) on average before surgery, and it improved to 1.8 cm (range, 1 cm - 6 cm, $p<0.001$) on average after surgery.

Before surgery, the average tibio-femoral angle was 18.50 (range: 15˚ to 25˚), but it improved to a mean value of 6˚ (range: 2˚ to 10˚) after surgery ($p < 0.001$). After surgery, the mean lateral distal femoral angle (LDFA) improved to 88.13˚ (range, 87˚ to 91˚ SD 2.029) from 76.23˚ (range, 72˚ to 83˚ SD 2.907) before surgery ($p < 0.001$).Prior to surgery, the mechanical axis deviation (MAD) was 19.56 mm (SD 6.625; range, 9 mm to 31 mm). After surgery, the mean MAD decreased to 3.7 mm

(SD 3.875; range, 0 to 5 mm, p<0.001). With a knee score of less than 28, two patients (7.4%) had a good functional outcome, and one patient (3.7%) had an unsatisfactory knee score of less than 20, out of the 27 instances, 24 had an outstanding outcome with a knee score of > 28.In one case, the implant had to be removed after four weeks due to a wound infection. Other problems such as non-union of the osteotomy site, knee stiffness, recurrence of the deformity, shortening, or reversal of the deformity were not present in any of the patients.

Discussion:

Surgery is necessary to correct a significant valgus deformity in order to improve biomechanics and enhance look, motion, and function. [15].In our investigation, we fixed the medial closure wedge DFO using a single K wire. This method was applied on adults and teenagers (age group: 15–23 years) by Gupta et al. In order to rectify the osteotomy location, they employed a buttress "L" plate. Of the patients, 95.6% had a great functional result.[10]

In a similar vein, Agarwal employed staples for fixation in all of the instances in his case series (pertaining to the 12- to 16-year-old age range).[1]. We employed modest implants (single K wire) and included a considerably younger age range (8–15 years) in our research group. In our dataset, 7.4% of patients had good functional outcomes, 88.8% of cases had outstanding outcomes, and one patient had an unsatisfactory knee score.

One of the method's standout benefits is how quickly it can be executed—it takes less than 45 minutes to complete. If desired, simultaneous correction of deformities in both limbs can be carried out; early union at the osteotomy site can be achieved; minor alignment adjustments can be made because Kirschner wire fixation is non-rigid; the above-knee cast can be immobilized for a limited period of time (6 weeks); and there is no need for a second, anesthetic-induced surgery to remove the implant.

Conclusion:

The single K wire fixation distal femoral medial closure wedge osteotomy is a rather easy, affordable, and effective deformity repair technique. It is an effective method that may be used in health-care institutions in poor nations like India since it corrects deformities in both limbs simultaneously in a single step, requires fewer and less expensive implants, and allows for a faster recovery of knee range of motion. We support the use of this method to treat genu valgum deformity in adolescents and young children while causing the least amount of disruption to their physical development.

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