Traumatology

Supracondylar opening osteotomy in the distal femur in a patient with genu valgum: Report of two cases.

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Abstract

Introduction: Opening supracondylar varus osteotomy (OSCVO) to correct genu valgus has good results, but it has complications such as delayed union and nonunion due to internal cortex (hinge) fracture. The incidence of hinge fractures is high. This study aims to describe an additional procedure to the usual external OSCVO technique to prevent internal hinge fracture and report its functional results.

Methods: In two cases that were operated on at the Alcívar Hospital in April 2024, the genu was described as arthritic valgus, the supracondylar opening osteotomy technique was performed, a Steinmann nail and an Acutrak screw were used to fix the internal hinge, and a bench bone graft was placed to fill the opening, which was fixed with a plate. We performed pre- and postsurgical telemetry, assessing the functional results with the KSS scale.

Results: Both patients consulted for valgus deformity and osteoarthritis. In one case, the osteotomy was unicompartmental with pain, and in the other, it was tricompartmental without pain. Postsurgical mobilization was performed immediately. In one patient, the osteotomy consolidated within 2 months, initiating full weight bearing; in the other, it took 3 months.

Discussion: OSCVO has a 93–100% survival rate at 5 years and an 83.3% survival rate at 10 years. Lateral OSCVO is associated with a risk of internal hinge fracture (up to 48%) and, therefore, a higher rate of bone consolidation complications. When we perform an OVSA to correct the axis, the most significant concerns are planning the osteotomy site and preventing hinge fracture with additional percutaneous fixation. After 6 months of evolution, we obtained outstanding functional results.

Conclusions: When the OVSA and contralateral hinge protection were used, favorable results were obtained regarding the function and stability of the affected knee, which is an effective treatment for patients with symptomatic genu valgum.

Keywords:

Opening osteotomy, genu valgum, hinge, arthrosis.

Abbreviations

KKS: American Knee Society score.

Additional information

No supplementary materials were declared.

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Authors' contributions

Hugo Ernesto Villarroel Rovere: Conceptualization, data curation, formal analysis, funding acquisition, investigation, writing - original draft, writing - original draft, writing - review and editing.

María Dolores Delgado Zambrano: Conceptualization, formal analysis, funding acquisition, research, writing - original draft, writing – review, and editing.

Manuel Enrique Betancourt Castillo: Funding acquisition, research, methodology, project administration, resources, software, and supervision.

Adrián Ernesto Villarroel Pérez, Conceptualization, data curation, formal analysis, funding acquisition, research, visualization, writing – original draft.
All the authors read and approved the final version of the manuscript.

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The authors funded the administrative costs of this research. The patients included in the study underwent surgical procedures covered by their private insurance. The surgical costs were adjusted to the standard rates of the trauma service, reflecting the usual market prices for this type of intervention.

Availability of data and materials

The datasets used and analyzed during the present study are available from the corresponding author upon reasonable request.

Introduction

Genu valgum is defined as a deficiency in the femorotibial axis (anatomical) beyond the physiological 6–8° of valgus and is characterized by a displacement of the mechanical axis toward the lateral compartment [1].

Coronal misalignment of the limbs contributes significantly to asymmetric joint wear, gait and developmental abnormalities, and the progression of degenerative joint disease. Knee osteotomies were developed to realign the mechanical axis of the limb and unload the affected compartment [2-5].

Varising osteotomy is an alternative in symptomatic patients with genu valgum who suffer from unicompartmental osteoarthritis. In this way, the load-bearing axis is transferred to the healthy medial compartment, reducing symptoms and delaying or preventing the need for arthroplasty.

In patients with genu valgum, distal femoral supracondylar osteotomy with a lateral opening wedge unloads the affected lateral compartment of the knee [2, 3]. This surgical technique may benefit young, active patients who wish to preserve long-term joint mobility and function without immediately resorting to total knee arthroplasty [6- 8].

Complications of Varus osteotomy, such as nonunion, delayed union, and hinge fractures, have been reported[6]. In previous reports, the incidence of hinge fractures (fractures of the inner cortex during the surgical procedure) ranged from 50% to 70%[7].

Therefore, preventing hinge fractures is essential for improving functional outcomes and bone consolidation. Our work aims to describe a procedure that, in addition to the usual supracondylar osteotomy technique, helps prevent internal hinge fractures when the opening is performed and to report the functional results.

Materials and methods

Surgical technique

Position

The patient is placed supine on a radiolucent operating table with the knee slightly flexed on a raised surface.

Surgical approach

The approach to the distal femur is oriented directly above the vastus lateralis. It begins approximately 3 cm distal to the lateral femoral epicondyle and extends approximately 5 cm proximally. After a sharp skin incision and blunt dissection, the muscular fascia of the vastus lateralis is reached. The supracondylar area is exposed after dissection with a periosteum remover and blunt Bennett retractors, and the important anatomical structures are identified and separated.

Osteotomy

A thick 3.5 mm Steinmann nail is placed as a cutting guide; this nail is placed obliquely at an angle of 15–20 degrees from the external supracondylar area toward the adductor tubercle in the internal condyle of the femur. On the internal side, in the hinge area, a thinner 2.5 mm Steinmann nail is placed; this nail travels through the internal condyle from bottom to top, leaving 1 cm of separation from the internal cortex. This nail performs the function of an internal stop that prevents the saw or chisel from invading the hinge area; it also protects and prevents the internal hinge from fracturing when the opening on the external side is made. The cut is made with an oscillating saw and is complemented with a chisel.

Opening and fixation of the osteotomy

Once the cut is made, the osteotomy is progressively opened with a spreader. An anatomical plate for the distal femur, the LISS type, is used for fixation. The plate can be molded to fit correctly on the external side. The plate that maintains the opening of the external base is fixed, and a 30-gram bench bone graft is placed. The Steinmann nail on the internal part was removed, and a headless Acutrak screw was placed.

Closing of tissues

It is sutured in layers; previously, we placed a drain.

Postoperative and Rehabilitation

After surgery, the knee is passively mobilized, isometric quadriceps exercises, bleeding control in the drain, and walking with crutches without support from the operated limb. Discharge is indicated on the second day postoperatively, and outpatient visits are scheduled for healing. After 15 days of stitch removal, a rehabilitation program may include improving the knee's range of motion, strengthening the surrounding muscles, and providing monthly clinical and radiological control. There will be no support until after 10 weeks of post-surgery, starting progressively with partial backing and then a full load.

Clinical cases

Case number 1

A 46-year-old female (4 years old) with pain in the right knee was treated conservatively and arthroscopically (medial meniscectomy). Currently, the pain increases EVA 7/10, and there is difficulty in performing daily activities, limiting walking; she walks with the help of crutches or a monopodal cane; on physical examination, there is valgus deformity of the knee (Fig. A). In the radiological study, there was grade II osteoarthritis of the external compartment of the knee (Fig. B), with

a genu telemetry value of 21 degrees and a deviation of the mechanical axis 5.7 cm from the center of the right knee (Fig. C). A supracondylar varus osteotomy of the distal femur was performed with an opening of the external base of 1.5 cm, fixation and protection of the internal hinge with a nail, and then an Acutrak screw. (Fig. D, E, F, G, H, I, J).

Figure 1. Graphic record of the clinical case.

Fig. A: 46-year-old patient with Genu valgum of the right knee. Fig. B: Grade II osteoarthritis of the external compartment of the right knee. Fig. C: In the telemería there is genu valgum of 21 degrees with a deviation of the mechanical axis of 5.7 cm outward from the center of the right knee. Graphic document of the Alcívar Hospital

Figure 1. Graphic record of the clinical case.

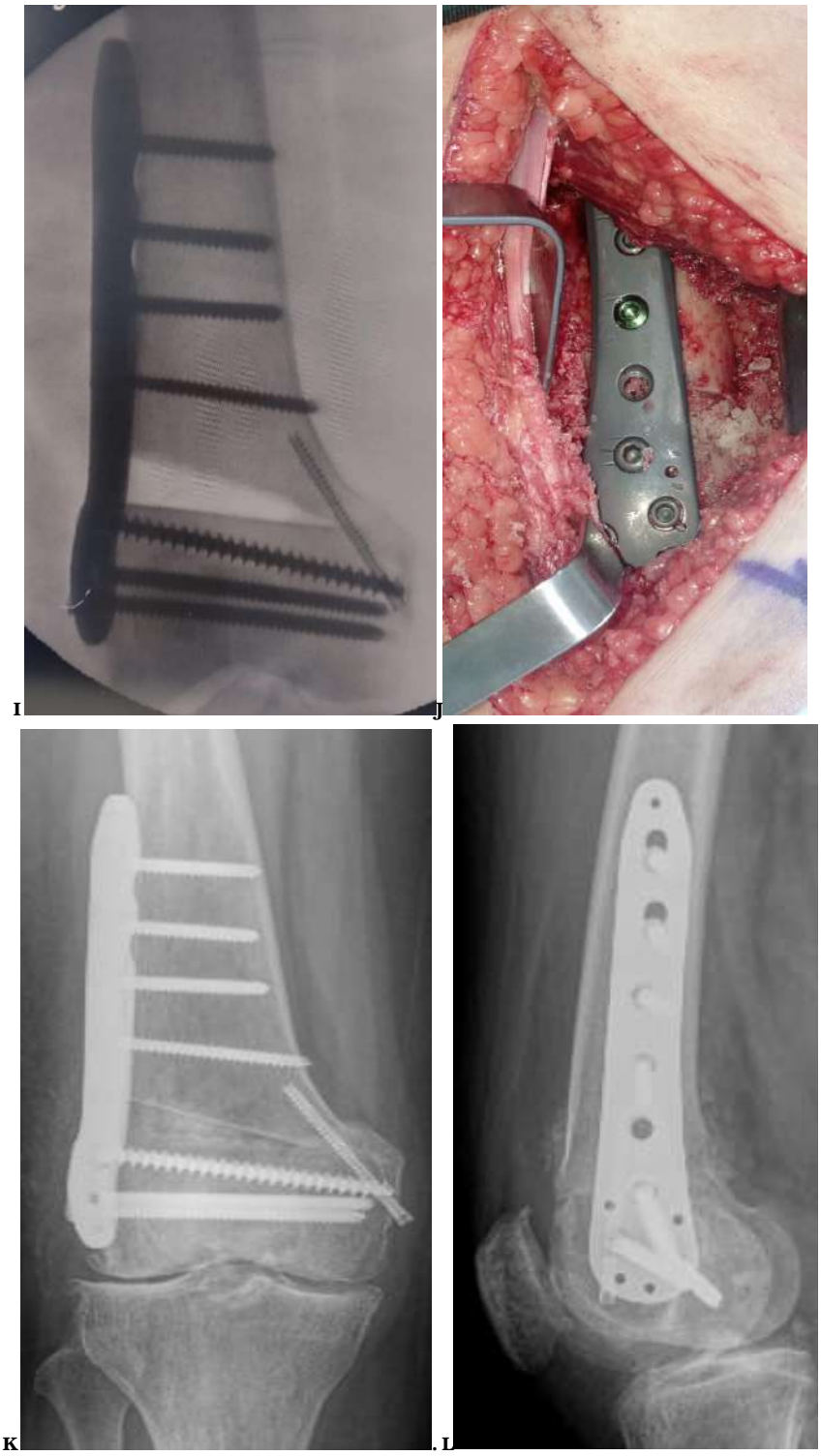
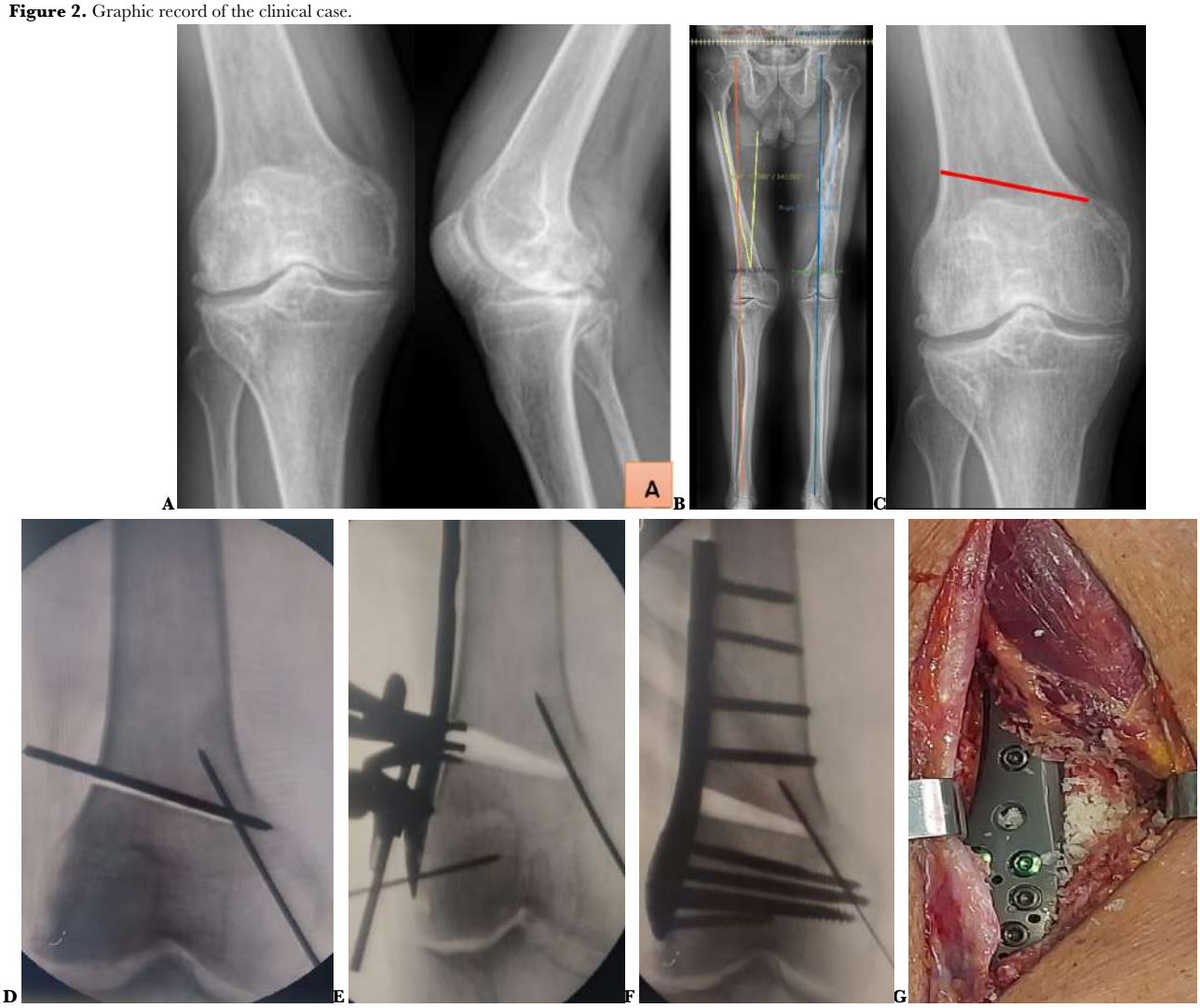


Fig. D: Presurgical planning of the cut, starting 1.5 cm above the external condyle and directed obliquely at an angle of 15 to 20 degrees toward the adductor tubercle. Fig. E: Fixation of the internal cortex with a 2.5 mm Steinmann nail at the site corresponding to the internal hinge. Fig. F: Placement of the 3.5 mm Steinmann nail as planned, this nail will serve as a guide for the cut with an oscillating saw and chisel, here the nail on the internal side protects us and prevents the cut from advancing beyond the hinge, the surgeon can feel when it hits the internal nail, protecting the area. Fig. G: A 1.5 cm opening is made with a Spreader clamp , the previously molded LISS plate is attached and fixed with the screws most proximal to the osteotomy. Fig. H: Plate fixation is completed with the remaining screws, the Steinmann nail on the internal side is replaced by a 4 mm Acutrak headless compression screw . Fig. I: The opening is filled with 30 grams of bench bone graft. Fig. J: Trans-surgical radiological control . Graphic document of the Alcívar Hospital.

Case number 2

A 70-year-old male patient presented with progressive deformity of the right knee. He has no pain and jogs and walks 3 km every day. He noticed that the deformity had recently increased and deviated from the axis of the foot, so he used a wedge in his shoe to stabilize his gait. The radiological study revealed grade III osteoarthritis (Kelgreen and Lawrence) in the right knee that affected mainly the external compartment, and telemetry revealed a 15-degree valgus deformity of the right lower extremity. The load axis deviated 3.31 cm from the center of the knee (Fig. A and B). A supracondylar varus osteotomy of the distal femur was performed with an external base opening of 1.5 cm, fixation and protection of the internal hinge with a nail, and then an Acutrak screw was used. (Fig. C, D, E, F, G, H, I).

Figure 2. Graphic record of the clinical case.



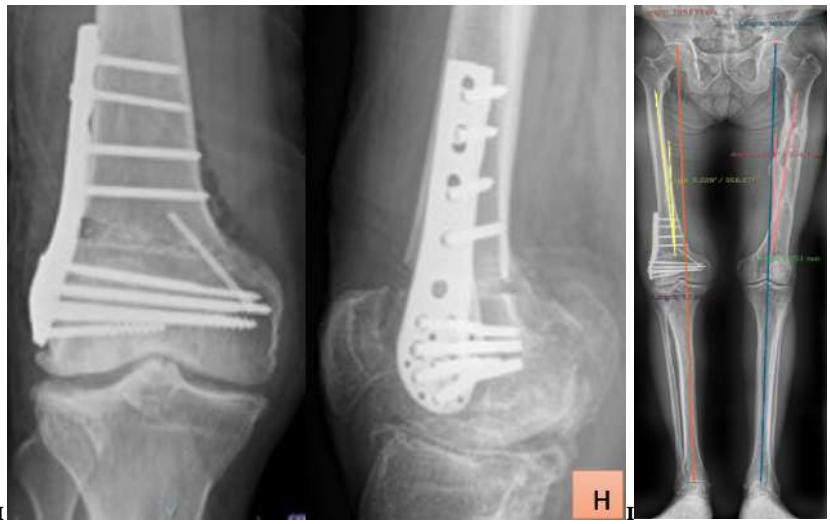


Fig. A: Grade III gonarthrosis (Kelgreen and Lawrence) right knee, with the external compartment more affected. Fig. B: In the telemetry, genu is observed Right valgum of 15 degrees, the loading axis deviated 3.31 cm outward from the center of the knee. Fig. C: Presurgical planning of the cut, it starts 1.5 cm above the external condyle and is directed obliquely at an angle of 15 to 20 degrees toward the adductor tubercle. Fig. D: Fixation of the internal cortex with a 2.5 mm Steinmann nail at the site corresponding to the internal hinge, then a 3.5 mm Steinmann nail is passed as planned, this nail will serve as a guide for the cut with an oscillating saw and chisel, here the nail on the internal side protects us and prevents the cut from advancing beyond the hinge, the surgeon can feel when it hits the internal nail, protecting the area and avoiding its fracture. Fig. E: 10 mm osteotomy opening with Spreader clamp , the molded LISS plate is attached. Fig. F: All plate screws are placed to stabilize and maintain the opening. Fig. G: The opening is filled with 30 grams of bench bone graft. Fig. H: Transoperative radiological control, the Steinmann nail was removed from the internal side and definitive fixation of the internal cortex was carried out with a 4 mm x 50 mm long Acutrak headless compression screw . Fig. I: Postsurgical telemetry, the axis of the right extremity is 3.02 degrees in valgus. Graphic document of the Alcívar Hospital.

Results

The data of the two treated patients were collected and summarized in Table 1. These two patients, in whom the additional technique of internal hinge protection has been used, are currently 6 months post-surgery. The osteotomy is fully consolidated, and the functional assessment with the American Knee Society Scale (KSS) has values greater than 85 points.

Table 1. Supracondylar Opening Osteotomy in Distal Femur for Genu Valgum. Protection of the internal hinge.

	Case 1	Case 2
Age	46 years old	70 years
Sex	Women	Man
Reason for consultation	Valgus deformity and pain.	Valgus deformity, without pain.
Knee osteoarthritis	Grade II uniconcompartmental osteoarthritis on the external side.	Tricompartmental osteoarthritis Grade III right knee
Genu Valgum presurgical telemetry	21 ^{0}, load axis deviation 4.5 cm outward.	15 ^{0}load axis deviation 3.3 cm outward.
Opening of the Osteotomy	15 mm	10 mm
Internal Hinge Protection	With Steinmann nail and then Acutrak screw.	With Steinmann nail and then Acutrak screw.
Osteosynthesis used	Liss plate.	Liss plate.
Filling the opening	Bank bone graft, Cancellous chips.	Bank bone graft, Cancellous chips.
Rehabilitation	• Isometrics and passive flexion-extension from the 1st day. • Active flexion-extension after 10 days. • Quadriceps strengthening after 15 days.	• Isometrics and passive flexion-extension from the 1st day. • Active flexion-extension after 10 days. • Quadriceps strengthening after 15 days.
Osteotomy Consolidation	At 2 months.	At 3 months.
Support	Partial support 6 weeks, full support 8 weeks.	Partial support 10 weeks, full support after 3 months.
Postsurgical telemetry	5 ^{0} valgus.	3.0 ^{valgus} .
KSS scale 3 months	87 points.	80 points.
KSS scale 6 months	95 points.	90 points.

Discussion

Medial closing wedge or lateral opening distal femoral osteotomies are two main surgical options for treating lateral compartment osteoarthritis with valgus knee deformity [8]. The supracondylar osteotomy procedure offers advantages, including restoration of height and reduced risk to neurovascular structures. A well-executed supracondylar osteotomy has a 93–100% survival rate at 5 years and an 83.3% survival rate at 10 years [9- 12].

The incidence of hinge fractures in closed wedges has been reported to be between 50% and 70% [7]. However, Berk AN reported that lateral opening osteotomy carries a greater risk of hinge fracture through the medial cortex and, therefore, a higher rate of complications of bone consolidation and even joint stiffness [9]. Similarly, Winkler reported that the incidence of contralateral hinge fracture in medial closing osteotomy was 35%, and in lateral opening osteotomy, the incidence was 48% [13- 14]. If the hinge fractures, rotational displacement occurs, and the stiffness of the contralateral fixation system decreases, requiring stabilization with an additional internal plate [15- 19].

Hinge fracture in supracondylar closure or opening osteotomies of the distal femur has always been a significant problem when performing either of the techniques, whether in the medial or lateral opening. It has reached nearly 50% of the cases. Hinge fracture has always been a problem because when osteotomy occurs, it becomes unstable, cannot be controlled rotationally, and is not easy to fix correctly. Even worse, this can cause us to lose the correction we seek to achieve and compromise the osteotomy's consolidation. Currently, when we perform a supracondylar osteotomy to correct the axis, our primary goal is to plan the osteotomy site and prevent hinge fracture with additional fixation.

The prevalence of delayed union is approximately 4% for medial closing osteotomy and approximately 6% for lateral opening osteotomy [6]. Eighty percent of patients with delayed nonunion had a contralateral hinge fracture.

In 2009, Puddu et al. [15] used a T-plate with an external metal wedge, performed a 20-degree oblique osteotomy with a guide nail, and left 1 cm of intact bone uncut as a hinge but without any protection to avoid fracturing the hinge. He mentioned that when a hinge fracture occurs, it is solved with staples through a contralateral incision. Here, the problem was solved if it appeared.

In 2023, Jae-Sung An [17] mentioned the correction of knee valgus with a medial closure osteotomy. Nevertheless, protecting the external hinge by placing a Kirschner nail, which is then replaced by a headless compression screw that allows bearing all the weight more easily and maintaining optimal safety or stability, patients return to work between 2 and 3 months, nonimpact sports (cycling, swimming, gym) at 4 months, pivot and high-impact sports should be contraindicated until complete bone healing is confirmed (4 to 6 months) on lateral and AP radiographs. Here, hinge fracture is prevented or avoided with additional fixation.

In 2014, Rosso F. [16] suggested that after a locking plate is placed on the lateral distal femoral cortex to traverse the lateral opening osteotomy site, a small plate can be placed on the medial cortex to relieve tension at the osteotomy articulation point and reduce the risk of fracture. Here, he mentions placing a medial plate to reinforce the hinge.

The mean time to bony union reported in the literature is approximately four months for medial closing osteotomy and three to six months for lateral opening distal femoral osteotomy [13]. In the patients in this report, osteotomy consolidation became evident three months postoperatively, and they were cleared for full weight bearing at that time.

In general, postoperative rehabilitation is faster, and weight bearing is performed 2 to 4 weeks earlier in the medial closing osteotomy than in the lateral opening distal femoral osteotomy [10]. Our two patients who underwent opening osteotomies at 6 months could already perform sports activities, and their functional assessment scale scores were 90 points for Patient #1 and 85 points for Patient #2.

Preoperative and intraoperative planning remains the key to the success of this procedure. Adequate planning can limit the known risk of collapse or loss of correction from hinge fracture and help facilitate reliable radiographic results [18].

Conclusions

External opening varus osteotomy for a valgus knee should be performed in conjunction with additional fixation at the contralateral medial hinge site as follows:

1. This provides better stability and rigidity to the osteotomy fixation system.
2. Avoid, above all, the fracture of the hinge.
3. Promote rapid consolidation of the osteotomy.
4. Obtain better functional results.

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Statements

Ethics committee approval and consent to participate

This method is not required for clinical cases.

Consent to publish

The authors have written permission to publish images, radiographs, and photographs of patients who have identified them.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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