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Novel physiotherapeutic approach for multiple fractures of lower limb managed by osteosynthesis plating and external fixator: a case report

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ABSTRACT

Introduction: As substantial force is required to create lower extremity fractures, both femur and tibia/fibula fractures are typical outcomes of large, high-energy trauma. The modes of damage for tibia fibula fracture are divided into 2 groups: low and high energy injuries. The first one includes ground-level falls and athletic injuries, whereas the latter one occurs due to include Road traffic accidents. Supracondylar femur fractures are those that affect the femur's distal 15cm. Getting Knee movements back to their pre-injury level may be challenging due to the closeness of these fractures to the knee joint. *Case Presentation:* A 49-year-old male with compound grade II right-sided supracondylar fracture, and compound grade III B mid-shaft tibia fibula fracture of the right side was diagnosed by an orthopedic surgeon, on X-ray after a collision with a truck while the patient was rid-ding a bike sustaining injuries to limbs and head. On which ORIF with osteosynthesis plating for femur and tibia inter-locking nailing was done followed by skin grafting for wound healing. Following surgery, the patient's limb movements were limited and were unable to conduct his daily activities. *Discussion:* After the operation, the patient was treated with physical therapy, which included static-dynamic exercises, breathing exercises, strengthening exercises, wheelchair mobilization followed by gait training. *Conclusion:* The patient benefited from physiotherapeutic techniques that allowed him to conduct his daily tasks independently, which improved his pain and functional results.

Keywords: Tibia fibula fracture, supracondylar fracture, physiotherapy rehabilitation.

1. INTRODUCTION

By definition, Supracondylar fractures are the fractures that affect the femur's distal 15 cm and the distal portion of femoral metaphysis with or without the participation of the articular surface of the distal femur. Traditional ORIF mending of femur distal fractures has long been known to have problems.

These issues have been linked to the fracture site's extensile exposure. Biological plating of femur distal fractures, like intramedullary nail fixation, maintains the tissues that are soft around the fracture and is linked with fewer chances of infection spread (Krettek et al., 2001). Supracondylar femur fractures often occur in 2 distinct groups and are caused by two distinct modes of injury. First, in young adults following high-energy trauma (60 percent males under 40 years; accidents and sports injuries), and second, in the senior population following low-energy trauma (60 percent females, older than 60 years; falls sprains, etc.) (Sahithya and Sultana, 2021). The sufferer who has soft tissue damage which is severe along with substantial articular cartilage destruction may experience long-term impairment. Getting Knee movements back to their pre-injury level may be a massive challenge because of the closeness of these fractures to the knee joint (Schatzker and Lambert, 1979). To avoid varus collapsing of knees on weight-bearing, care should be taken for adequate and proper fixation of the fractured site (Jha et al., 2018).

Patients suffered distal tibia fractures due to transmission of force from the lower to the upper part of the lower limb causing tragic injuries such as falls, automobile accidents, motorcycle accidents, or sports injuries (Vaienti et al., 2019). Because properly re-aligning and e-constructing the broken bone using rigid stabilization are occasionally required, Intramedullary nailing, (MIPO), Open reduction, and External fixation were all standard surgical methods (Liu et al., 2019). Proper re-alignment and re-constructing of the broken chips are necessary. Surgical stabilization is a better option for treating proximal tibia fractures (Tasheva et al., 2020). Deracination of bone, loss of bone, injury to soft tissues, infection, and various injuries linked with the treatment may have a detrimental impact on the prognosis (Demiralp et al., 2007).

According to guidelines published by an expert who aims to highlight a structured treatment approach for FRI based on a comprehensive view of proper surgical wound debridement managed via dead space available, proper fracture fixation (if needed), soft tissue coverage of robust tissue, and adequate antibiotics (Metsemakers et al., 2020). The basis of this medical device is to dress the wound bed by creating negative pressure over the wounded area, by which fluid is sucked away from the area. The indications of this treatment are to enhance wound management processes, preparation of wounds for debridement, and other surgeries wounds. Decreasing the chances of infection, and can shorten the time for wounds recovery. According to a recent article, the application of Low-intensity direct current accelerates wound healing through the increase of growth factor and fibroblast activity. The use of an NWP device for wound treatment entails the use of a vacuum dressing of the wound bed, thus creating negative pressure which permits wound and tissue fluid to be sucked and collected into a canister. This method was used in our circumstances after re-evaluating the situation of the wound, and when the debridement wound procedure was completed.

Every four days, the dressing of the wound got replaced. According to Angelis et al., (2019) taking into account the patient's needs is important. A seven-day interval was used to assess patient comfort, NPWTS expenses, and ultimate flap results. It is appropriate to have a period between NPWTS modifications. The use of (LIPUS) is to aid in fracture healing in recent fractures. Frequency of 1.5 MHz frequency, a 200-second width of produced burst, a 1 kHz signal repetition frequency, and 30mW/cm2 intensity. 2 double-blind controlled trials using LIPUS for speeding up wound healing in the tibia and radius were conducted in the year 1994 and year 1997, respectively. They concluded that this increases fracture healing from 24% to almost double for recent fractures. However, several studies have found no favourable impacts. In the categories with negative variables for healing fractures, the therapeutic ramifications of LIPUS on fracture recovery were thought to be greater. Delay in unionization and non-unionization account for 5% of all cases (Watanabe et al., 2010).

2. PATIENT INFORMATION

A 49-year-old male patient with the dominance of the right side, a biology teacher by profession, had a collision with a car while riding a bike with his friend, causing him to fall on the right side of the road. After that, he was unable to move his limbs and was profusely bleeding. He was rushed immediately to a nearby clinic by his friend where primary treatment was given and was immediately referred to AVBRH, Sawangi for further treatment. After consulting an orthopedic surgeon X-rays were performed. The patient underwent surgical treatment of ORIF with an external fixator for tibia fibula fracture osteosynthesis plating for supracondylar fracture and vacuum-assisted closure for wound healing followed by skin grafting over the wound. Physiotherapy sessions were started once the patient was stable. After surgery patient had complaints of pain, swelling, and decreased movements of the lower limb. No significant personal or family history is present. The patient is not addicted to any habits.

Investigations

X-RAY

Reports suggested it to be compound grade II supracondylar femur of the right side and compound grade III B mid-shaft tibia and fibula fracture of the right side which was managed via osteosynthesis plating and external fixator (Figure 1 and 2).

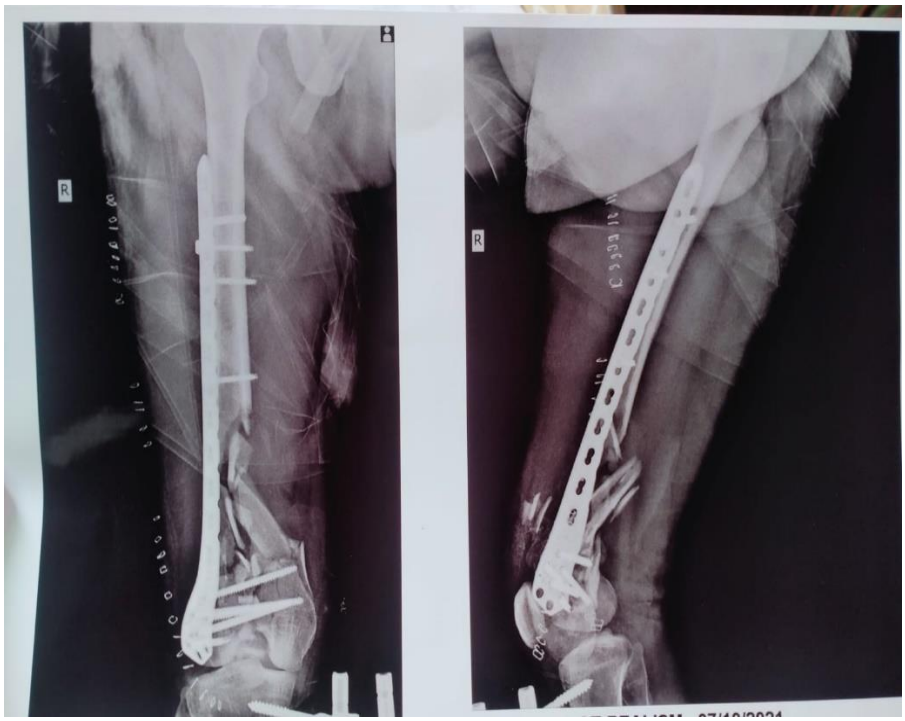

Figure 1 X-ray showing osteosynthesis plate on femur bone.

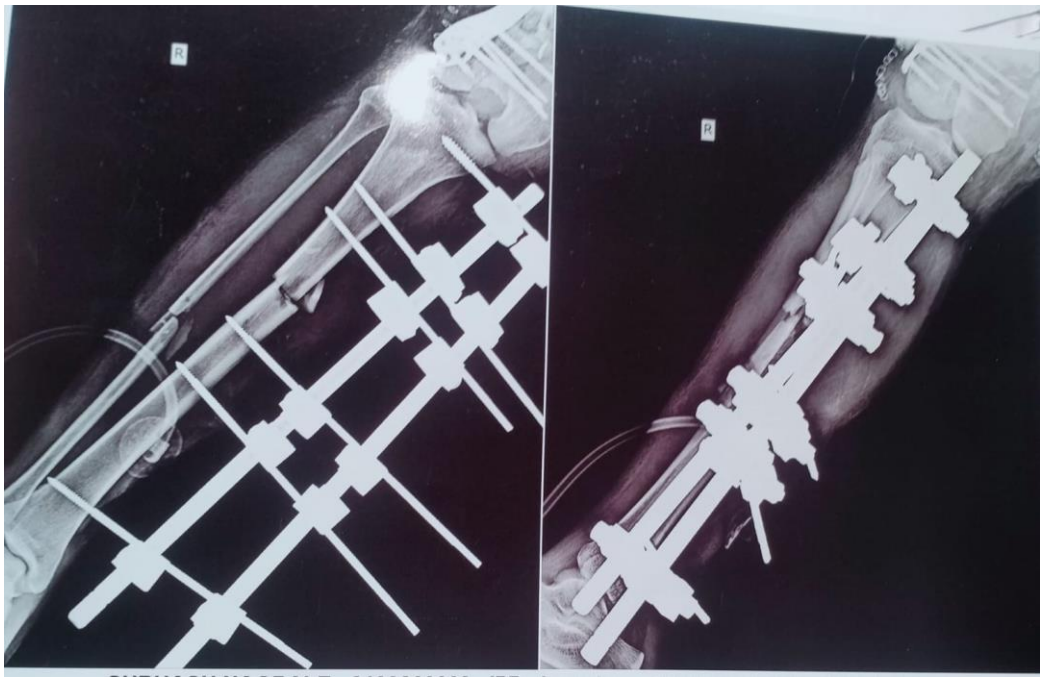

Figure 2 External Fixation done for the fractured bones.

3. CLINICAL FINDINGS

A properly written and explained consent was taken from the patient. The patient was explained about the examination part and further interventions. On general examination, the patient was cooperative, conscious, and well oriented to time place person. The patient hemodynamic was normal, was febrile with BP- 130/78 mm Hg, Pulse was 95 beats/min and R.R was 20 cycles/min. Cyanosis, Clubbing, Icterus, Oedema absent. On the NPRS scale pain grade was 9/10 on activity and 6/10 at rest. The examination was done under the subheadings of Observation, Inspection, and Palpation. Observatory findings are: Patient was examined in supine position with hips and knees extended and right leg supported through the pillow. The patient is a fairly built 49-year-old

male. There was a presence of scar over the posterior area of the knee joint. A vacuum-assisted closure device was applied over the wounded area. Palpatary findings are: Presence of grade III tenderness, Temperature of the local area was raised. The ROM is mentioned in the table below (Table 1). Hip and ankle-toe movements are present. Straight leg raise could not be elicited due to fracture and pain. On neurological examination all superficial and deep sensations and reflexes were normal.

Examination finding

Table 1 ROM Assessment On day 1 of physiotherapy treatment

	Joint movement	Right		Left	
		Active	Passive	Active	Passive
Hip Joint	Flexion	NA	0-30	0-110	0-120
	Extension	NA	0-15	0-15	0-18
	Abduction	NA	0-35	0-40	0-48
	Adduction	NA	0-15	0-26	0-30
Knee Joint	Flexion	NA	NA	0-135	0-135
	Extension	NA	NA	135-0	135-0
Ankle Joint	Plantar flexion	0-40	0-50	0-50	0-50
	Dorsiflexion	0-5	0-10	0-10	0-10
	Inversion	0-20	0-35	0-30	0-35
	Eversion	0-10	0-15	0-10	0-15

Therapeutic Interventions

Every week, the physiotherapy rehabilitation plan was tweaked with new therapeutic activities patient education, pain reduction from 9/10 at the movement to 2/10. On the NPRS scale, respiratory complications prevention, improved range of motion, Adding strength of lower limb muscles quadriceps, hamstrings, hip adductors, and gastrocnemius muscle, and early mobility promotion were the short-term goals, while the long-term goals were to prevent secondary complications, promote independent walking with or without a frame, improve static and dynamic balance, improve endurance, and restore functional activities of daily living. The first and the most thing, Psychological consultation and proper awareness about the condition were given as he was not mentally stable regarding the same and he was the bread-winner of the Family, so everyday motivation and a friendly environment were provided.

Phase 1 (Zero to Two Weeks)

For the first 10 days (Affected extremity) - During the first week, the wound was checked for infection and erythema and the frequent bed turns to prevent bedsores. For 10 minutes, cryotherapy and ultrasound were used to relieve pain. Foot ends were kept elevated to prevent limb swelling. Gentle active range of motion exercises to the hip, knee, and ankle were commenced. Ankle toe movements (20 repetitions) were done to prevent thrombophlebitis and deep vein thrombosis (Figure 3). The patient was encouraged to perform knee exercises with a goal of full extension and 60-90 degrees of knee flexion. The patient was educated to put on pants with the affected extremity and doff them from unaffected extremity to decrease stress on the fracture site. Wheel Chair mobilization was done (Figure 4). Movements like hip abduction, flexion, and extension movements were performed to reinforce a non-weighted position. For (unaffected extremity)-Range of Motion and strengthening exercises were done along with breathing exercises.

Phase 2 (Two to Six weeks)

Many aspects of the phase one regimen were maintained as needed. The precaution was taken to avoid rotatory movements; Gentle active range of motion exercises to the hip, knee, the ankle was commenced. Ankle toe movements (20 repetitions) were maintained. Progression was made with starting of isometric exercises to glutei, quadriceps, tibialis anterior, gastrocnemius, and soleus with contraction of the muscle initially and then holds for 5 sec with 10 repetitions. Soft tissue mobilization and patellar glides were commenced. Short ranges of knee bends (0-60) degrees were started with 10 repetitions of 2 sets. Self–controlled mobilization by continuous passive movement (CPM) was also started (Figure 5). Non-weight bearing crutch walking was begun at the end of 2 weeks. To prevent chest complications pursed-lip breathing exercises were taught. With the progression of gait training 3 point gait, crutch or walker commenced with toe-touch weight-bearing by the conclusion of this phase.

Figure 3 Patient performing Ankle toe movements.

Figure 4 Showing Wheelchair Mobilization

Phase 4 (Six to Eight weeks)

Many aspects of the phase three regimen were maintained as needed. The goal of the exercise was to improve flexibility, coordination, kinaesthetic, and strength preparation in the lower limb by participating in the phase of weight-bearing. Passive Movement exercises to the hip, knee, and ankle were started. Gentle progressive exercises to quadriceps, dorsiflexion, and plantar flexors were started. Electrical stimulation has improved muscle fiber recruitment for functional activities by causing faradic activation of the quadriceps and hamstrings. With little or no help, dynamic quadriceps motions have improved. For hip and knee advancement, exercises such as heel to shin movement, bedside sitting, aided and self-resisted movements were performed. To prevent chest complications breathing exercises, thoracic expansion exercises, and spirometry (Figure 6) was taught.

Phase 5 (Eight to Twelve-week)

Many aspects of the phase four regimen were maintained as needed. In addition, to enhance stability and predictive activities, the focus was also on improving lower extremity strength. Passive range of motion and stretching exercises were continued. Progressive strengthening exercises progressed. Resisted and dynamic exercises to Quadriceps, Hamstring, and glutei were progressed. Ambulation using a walker enhanced the confidence of the patient.

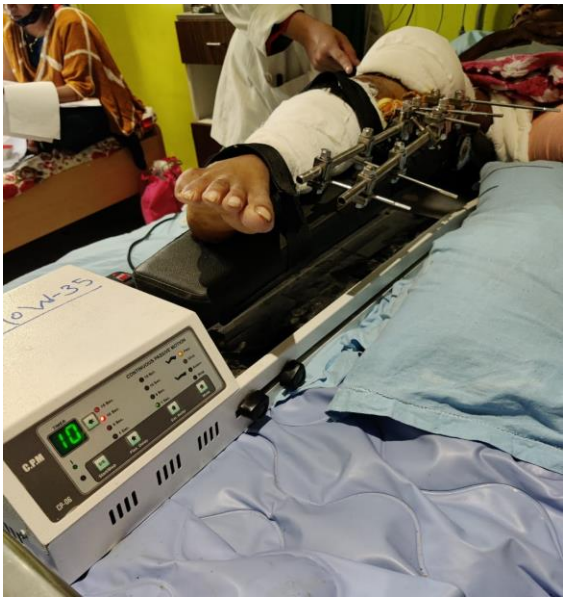

Figure 5 Depicting application of CPM.

Figure 6 Performing Incentive Spirometer

Phase 6 (Twelve to fourteen weeks)

Many aspects of the phase five regimen were maintained as needed. Increased tolerance to progressive resistance exercise led to an increase in exercise time which was aimed at improving the patient's condition. Weight-bearing in locomotion preparation was improved, which boosted the confidence of the patient in ambulation. Activities for gait fitness such as spot marching, climbing-stairs, Isotonic and isokinetic exercises, and fully active and passive range of motion exercises with resisted devices were given to lower limbs.

Home Exercise Program

The patient was educated to follow all modification advice, all the strength maintaining exercises to be done and complete weight-bearing walking with walkers to be continued.

Follow up and outcomes

Mostly following the completion of physiotherapy, the patient reported normal functional activities without pain complaints or limited joint movements. On his right lower limb, he possessed a full range of joint movement and muscular strength of 5 degrees (Table 2 and 3). After that, the patient resumed backs his normal activities and work.

Table 2 Range of Motion assessment done on completion of physiotherapy treatment

	Joint movement	Right		Left	
		Active	Passive	Active	Passive
Hip Joint	Flexion	0-100	0-95	0-110	0-120
	Extension	0-15	0-18	0-15	0-18
	Abduction	0-40	0-45	0-40	0-48
	Adduction	0-25	0-26	0-26	0-30
Knee Joint	Flexion	0-110	0-60	0-135	0-135
	Extension	0-90	0-100	135-0	135-0
Ankle Joint	Plantar Flexion	0-50	0-50	0-50	0-50
	Dorsiflexion	0-10	0-10	0-10	0-10
	Inversion	0-20	0-30	0-30	0-35
	Eversion	0-10	0-15	0-10	0-15

Table 3 Manual Muscle testing Pre and Post Physiotherapy

Joint Movement	Pre Physiotherapy		Post Physiotherapy	
	Right	Left	Right	Left
Hip flexors	1/5	4/5	3/5	5/5
Hip Extensors	2/5	4/5	4/5	5/5
Hip Abductors	2/5	4/5	4/5	4/5
Hip Adductors	2/5	4/5	4/5	4/5
Knee flexors	1/5	4/5	3/5	4/5
Knee Extensors	1/5	4/5	3/5	4/5
Ankle Plantar flexor	3/5	4/5	4/5	5/5
Ankle dorsiflexion	3/5	4/5	4/5	5/5

4. DISCUSSION

As a result, the main notion for femoral, tibia, and fibula fractures is that the approach to therapy for each case requires thoughtful, individualized planning. The pain associated with these fractures is usually gradual and progressive. There is no consistent information regarding the results of treatment of managing Supracondylar femur fracture therapy. When we try to compare results of various reported series, Then the result of the literature is tricky because of disparities in demographics and socioeconomic status for different fractures, and it's made much more difficult by several classifications and functional rating systems The outcomes for various fracture groups should be evaluated independently, otherwise "mix" of fractures will occur (Reddy et al., 2019). The rise in vehicular accidents and high-velocity trauma not only increases the number of femur distal fractures (which account for about 7% of all femoral fractures) but also increases the number of femoral fractures (which account for about 7% of all femoral fractures)in

addition to their complexity Distal femur fractures is difficult to treat. As they are usually comminuted, they should be reduced, aligned, and stabilized. Very easily distorted by muscle stresses at the distal end fragment (Mathur et al., 2017).

Various treatment methods for supracondylar femur fractures have been presented over the years, including conservative management with bone traction and fixed with dynamic traction. However, condoler screws and retrograde intramedullary nailing have recently become popular (Jha et al., 2018). Tibia-fibula's spiral and oblique fractures, which are considered unstable fractures, can be treated in numerous ways, ranging from closed reduction to external fixation. Rapid and perfect healing, minimal loss of function, and prevention of deformity are all goals in the rehabilitation of these fractures. Many studies have been conducted for this purpose, intramedullary nail has been utilized as the therapy of choice for Tibia-fibula segmented diaphyseal tibia-fibula transverse, short use these procedures, such as angle-stability and multi-use distal screws, in tibia fractures to maintain alignment, and prevent malunion, after oblique intramedullary nail, plate fixation, or percutaneous treatment for fractures. MIPO was concluded to be more effective than IMN at preventing malunion, and intramedullary nailing looked to have fewer wound problems.

MIPO, moreover, was more suggested in patients with 43A distal tibial fractures for its ability to avoid malunion. Whatever approach we use, we must be aware of and avoid any potential difficulties. Surgeons began with the advent of IMN design and adjunctively surgical techniques. Also, tibia and fibula fractures are the hallmarked fractures for delayed return to sport and normal activity (Zaki et al., 2020). Skin grafting along with VAC application has shown tremendous healing as VAC works by decreasing pressure over the wound, Thus accelerating healing. The NPWTS was used in our patients after the wound had been re-evaluated and debridement had been completed. Furthermore, granulation tissue development is stimulated by an increase in circulation caused by tissue tension. The elimination of wound exudate and associated enzymes minimizes the additional destruction of cells and keeps the surrounding skin dry by reducing skin dressing changes. The VAC seals the opening by applying negative pressure on the wound bed with the help of a foam dressing. Combined with the production of granulation is aided by decreasing edema and enhancing blood flow and then a split skin graft to close the incision (Angelis et al., 2019).

In terms of hamstring flexibility, both the energy technique of muscles and ART are very useful and beneficial. The ligament can sometimes be fully torn away from the thigh bone. At the same time, other injuries may occur. Other ruptured knee ligaments (particularly the medial collateral ligament), a torn knee cushion, or bruising on bone are examples. Gait training can be done using motor learning principles in those who can walk. Repetitive practice is essential for a positive outcome. The therapist uses hand touch to teach postural control to rectify the trunk posture. While gait training, mirrors are employed to provide visual feedback (Birelliwar and Athawale, 2020). After surgery, limiting weight-bearing status worsens rehabilitation by prolonged reliance on supporting devices for ambulation and the necessity for the patient to survive in a long-term care institution. In distal femoral peri-prosthetic fractures, early weight-bearing is beneficial. By mandating speedy completion, you can promote successful regeneration while keeping complication levels low.

Post-traumatic somatic symptoms, despair, and anxiousness are commonly observed repercussions of extensive bone fractures. Depression is frequent after an accident and may have an impact on medical outcomes. In addition, the inability to recover at a level of a functioning previous to the fracture may lead to mental health problems. Injury recurrence, readmissions, and increased individual and social health care expenses may be exacerbated by a lack of social help. Using caregivers with psychological and social care experience can help patients reach their recovery objectives by offering emotional support. We adequately informed the patient about the process, the potential challenges, and the phases following the operation, in terms of what to expect and how to proceed. This is critical for improving the patient's psychological state and making them more capable of dealing with post-operative issues. If the patient maintains an optimistic response, the chances of good rehabilitation and a quicker return to regular activities improve are mandatory.

5. CONCLUSION

From this study, Physiotherapy, which includes interventions such as early ambulation and the prescription of properly structured and thoughtful exercise programs for maximizing functional recovery and minimizing the chances of falls as well as further injuries, can play an essential part in the roadway of care for people who have suffered a fragility fracture.

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Author Contributions

ARS led the formation of the manuscript, ML suggested changes for manuscript processing, PP read and approved the final manuscript for publication. Overall every author contributed equally.

Abbreviation

ROM- Range of Motion
ORIF- Open Reduction and Internal Fixation
NPRS- Numerical Pain Rating Scale
VAC- Vacuum-Assisted Closure
NA- Not-Available
CPM-Continuous Passive Motion
VMO-Vastus Medialis Oblique
IMN- Intramedullary Nailing
LIPUS- Low-intensity pulsed ultrasound
NWP- Negative wound pressure
NPWT- Negative Pressure Wound Therapy

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Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

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