

Early mobilization and wound care after knee arthrodesis for tibial chondrosarcoma: a case report

Mobilisasi Dini Dan Perawatan Luka Pasca Arthrodesis Lutut Pada Kondrosarkoma Tibia: Laporan Kasus

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ABSTRACT

Background: Proximal tibial chondrosarcoma is a malignant bone tumor requiring wide resection and often causing challenges in wound management and lower-limb functional recovery. In resource-limited healthcare settings, knee arthrodesis remains an important limb-salvage procedure when endoprosthesis reconstruction is unavailable. However, evidence regarding nursing-based postoperative wound care and early mobilization remains limited.

Objective: This case report describes the implementation of an evidence-based nursing approach integrating early mobilization with objective monitoring of wound healing and functional outcomes following knee arthrodesis.

Case: A 40-year-old male with grade 2 proximal tibial chondrosarcoma underwent wide resection followed by knee arthrodesis using plate-screw fixation and bone cement. Postoperatively, the patient experienced massive bleeding resulting in anemia, leucocytosis, severe lower-limb muscle weakness, restricted mobility, and partial functional dependence.

Intervention and Outcomes: Daily nursing assessments were conducted using the Bates-Jensen Wound Assessment Tool (BWAT) and the Modified Iowa Level of Assistance Scale (mILOA). Early mobilization was initiated on postoperative day two. Over 19 days, BWAT scores improved from 24 to 13 without wound dehiscence, accompanied by increased functional mobility and reduced dependence from partial assistance to minimal assistance.

Conclusion: Early mobilization combined with BWAT- and mILOA-based monitoring may provide a safe, practical, and sustainable nursing strategy to support wound healing and functional recovery after knee arthrodesis in resource-limited settings.

Keywords: arthrodesis, chondrosarcoma, early mobilization, wound healing

ABSTRAK

Latar Belakang: Kondrosarkoma tibia proksimal merupakan tumor tulang ganas yang memerlukan reseksi luas dan sering menimbulkan tantangan dalam manajemen luka serta pemulihan fungsi ekstremitas bawah. Pada fasilitas kesehatan dengan keterbatasan akses terhadap rekonstruksi endoprostetik, artrodesis lutut tetap menjadi pilihan limb-salvage untuk mempertahankan ekstremitas dan mencegah amputasi. Namun, bukti terkait perawatan luka pascaoperasi berbasis keperawatan dan mobilisasi dini masih terbatas.

Tujuan: Laporan kasus ini bertujuan mendeskripsikan penerapan pendekatan keperawatan berbasis bukti yang mengintegrasikan mobilisasi dini dengan pemantauan objektif kondisi luka dan luaran fungsional pasca artrodesis lutut.

Kasus: Seorang laki-laki berusia 40 tahun dengan diagnosis kondrosarkoma tibia proksimal derajat 2 menjalani reseksi luas dilanjutkan artrodesis lutut menggunakan fiksasi plate-

screw dan semen tulang. Pascaoperasi, pasien mengalami perdarahan masif yang menyebabkan anemia, leukositosis, kelemahan otot ekstremitas bawah, keterbatasan mobilitas, dan ketergantungan fungsional parsial.

Intervensi dan Hasil: Penilaian harian dilakukan menggunakan Bates–Jensen Wound Assessment Tool (BWAT) untuk memantau penyembuhan luka dan Modified Iowa Level of Assistance Scale (mILOA) untuk mengevaluasi mobilitas fungsional. Mobilisasi dini dimulai pada hari kedua pascaoperasi. Selama 19 hari, skor BWAT menurun dari 24 menjadi 13 tanpa dehisensi luka, disertai peningkatan mobilitas fungsional dan penurunan tingkat ketergantungan dari bantuan parsial menjadi bantuan minimal.

Kesimpulan: Integrasi mobilisasi dini dengan pemantauan berbasis BWAT dan mILOA berpotensi menjadi strategi keperawatan yang aman, praktis, dan berkelanjutan dalam mendukung penyembuhan luka serta pemulihan fungsi pasca artrodesis lutut pada fasilitas kesehatan dengan sumber daya terbatas.

Kata kunci: arthrodesis, chondrosarcoma, mobilisasi dini, penyembuhan luka

INTRODUCTION

Chondrosarcoma is a malignant bone tumor characterized by the production of a cartilaginous matrix and represents the second most common primary bone malignancy in adults and incidence is estimated at 1 per 200,000 population, accounting for approximately 25% of all primary bone tumors. Globally, chondrosarcoma predominantly affects males, with a peak incidence between 40 and 70 years of age. In Indonesia, individuals over 40 years old have a 5.3-fold higher risk of developing malignant bone tumors, including chondrosarcoma.^{1,2}

This tumor demonstrates a high degree of resistance to chemotherapy and radiotherapy; therefore, wide surgical resection remains the cornerstone of chondrosarcoma management.^{3,4} When the proximal tibia is involved, knee arthrodesis may be selected as a limb-salvage strategy. However, this procedure is associated with substantial postoperative risks, including pain, limited mobility, bleeding, and wound-related complications.⁵ Consequently, postoperative outcomes are influenced not only by surgical success but also by the quality of rehabilitation and wound management.

Early mobilization following extensive lower-extremity resection, which may predispose patients to joint stiffness, remains underreported in the literature. Nevertheless, available evidence indicates that structured early rehabilitation plays a critical role in preserving muscle mass, improving range of motion (ROM), and accelerating functional adaptation. However, the Modified Iowa Level of Assistance Scale (mILOA) and the Bates–Jensen Wound Assessment Tool (BWAT) are validated instruments that allow objective evaluation of functional mobility and wound healing progression in hospitalized patients.^{6,7} Effective wound care is therefore essential in patients undergoing major reconstruction for bone tumors to prevent postoperative complications.

Proximal tibial reconstruction carries a high risk of wound dehiscence due to limited soft-tissue coverage, necessitating effective drainage management and the use of moisture-retentive dressings to optimize healing and offloading.^{8,9} Objectively measured early mobilization has been shown to significantly improve functional mobility and reduce postoperative dependence. Meta-analyses of randomized controlled trials (RCTs) in lower-extremity surgery demonstrate that mobilization initiated within the first 24–48 hours postoperatively accelerates the achievement of key functional milestones, including standing, ambulation, and safe transfers.¹⁰ Based on these considerations, this case report

examines a patient with significant activity limitations and joint stiffness following extensive surgery and evaluates accelerated recovery using BWAT to monitor wound healing progress and mLOA to assess functional mobility during early mobilization.

METHODS

Patient information

This case report describes a 40-year-old Indonesian male working as a cleaning service staff member at a primary school, whose occupation involves physically demanding activities, including lifting heavy loads, prolonged standing, and weight-bearing tasks. The patient experienced blunt trauma to the left lower extremity after slipping at work and has a history of smoking since adolescence. Prior to seeking medical treatment, the patient underwent traditional massage therapy, which contributed to a delayed diagnosis, with a mass in the proximal tibia having been present for approximately eight years before presentation to a healthcare facility.

Clinical findings

On postoperative day two following knee arthrodesis, the patient was clinically stable but exhibited significant functional limitations due to fixed knee extension from internal fixation. Mild edema was present in the left thigh and leg without signs of infection, and the surgical wound was clean with well-functioning vacuum drains. Hip motion on the affected side was absent, while ankle mobility was limited but preserved, accompanied by marked muscle weakness of the operated limb (MMT 2/5) and moderate pain (VAS 5/10). Neurovascular status remained intact, and functional assessment revealed partial dependence (Katz ADL 4/6). These findings indicate a stable early postoperative condition suitable for initiating early mobilization and isometric rehabilitation.

Timeline of care

The clinical course demonstrated steady improvement from preoperative staging through early postoperative rehabilitation. Despite significant intraoperative blood loss, the patient remained hemodynamically stable and showed progressive gains in mobility and wound healing, supporting the effectiveness of structured early mobilization and moisture-balanced wound care in 3 weeks.

Diagnostic assessment

A comprehensive diagnostic evaluation confirmed the diagnosis of grade 2 chondrosarcoma of the proximal left tibia. Histopathological examination revealed a hypercellular cartilaginous tumor composed of pleomorphic and hyperchromatic chondrocytes, some binucleated, embedded in a chondroid matrix with myxoid stromal changes, active mitoses, inflammatory cell infiltration, and focal hemorrhage, consistent with a moderately aggressive malignancy. Radiographic assessment demonstrated a lytic lesion with chondroid matrix formation in the epimetaphyseal to epimetadiaphyseal region of the proximal tibia without joint involvement or fracture, supporting the malignant neoplastic process. Postoperative imaging confirmed stable knee arthrodesis with plate-and-screw fixation and adequate bone cement filling (figure A1,B1,C1 and D1), while laboratory findings showed transient leukocytosis that normalized by postoperative day six, indicating the absence of infection. Delayed presentation due to reliance on traditional therapy and socioeconomic constraints posed diagnostic challenges; however, integration of clinical, radiological, and histopathological findings established the final diagnosis and guided definitive surgical management and postoperative rehabilitation.



Figure 1. Preoperative radiographic evaluation. (A) Shows knee radiographs obtained in two projections (anteroposterior [ap] and lateral) for assessment of the knee joint. (B) Presents left crural radiographs in anteroposterior and lateral views to evaluate tibial involvement and surrounding structures. Intraoperative and postoperative radiographic views demonstrating knee arthrodesis with internal fixation. (C) Illustrates the knee arthrodesis construct following wide tumour resection. (D) Shows plate-and-screw fixation applied to the distal third of the left femur to achieve stable alignment and rigid fixation.

Therapeutic Intervention

The patient underwent definitive surgical treatment consisting of wide tumor resection of the proximal tibia followed by knee arthrodesis (figure A8) to achieve oncologic control and long-term limb stability. Structural reconstruction was reinforced using bone cement, and the wound was closed in layers to protect soft tissue integrity. Two vacuum drains were placed (figure B8) to control postoperative exudate and prevent hematoma formation. Intraoperative blood loss was managed appropriately, and no major surgical complications occurred. These surgical measures provided a stable reconstruction and controlled wound environment, forming the basis for subsequent postoperative nursing interventions, including wound monitoring, drain management, pain control, and the safe initiation of early mobilization.

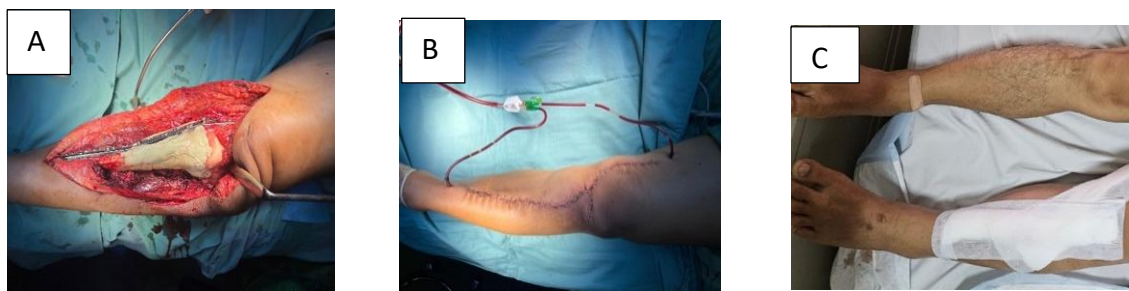


Figure 2. Procedure surgery: (A) Joint reconstruction of the knee was also performed to restore structural stability following bone resection, and Following implantation, bone cement was applied to fill the gap between the bone and the implant (B) Subsequently, soft tissue coverage was performed using a flap, and a surgical drain was placed at the operative site to support wound healing and prevent fluid accumulation (C) Condition of the Patient Leg Following Knee Arthrodesis

During the postoperative phase, the patient underwent definitive surgical management consisting of wide tumor resection followed by knee arthrodesis to achieve oncologic control and limb stability (figure A8). Postoperatively, nursing interventions focused on supporting recovery, preventing complications, and optimizing functional outcomes rather than detailing technical surgical procedures

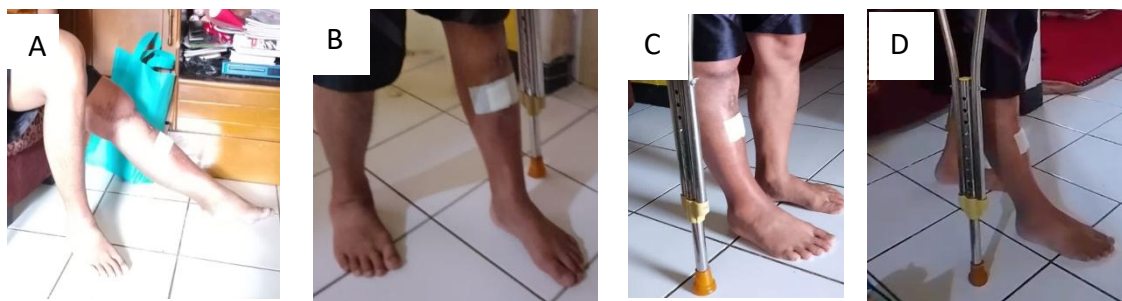


Figure 3. Evaluation Of Early Mobilization Progress For (A) Sitting Position; (B) Standing Position; and Ambulation Using A Walker

Early postoperative nursing care emphasized close monitoring of wound condition, drainage output, pain, and neurovascular status. Vacuum drains were maintained to control exudate and prevent hematoma formation, while foam dressings were applied to maintain a moist wound environment and protect soft tissue integrity (figure C8). Drain output and wound condition were monitored daily, and wound healing progress was evaluated serially using the Bates–Jensen Wound Assessment Tool (BWAT).

Early mobilization was initiated on postoperative day two as a core nursing intervention to prevent immobilization-related complications. Interventions included quadriceps isometric exercises, ankle pump movements, and gradual position changes to maintain muscle activation and circulation. Mobilization progressed in a stepwise manner according to patient tolerance and limb stability, with all activities supervised to ensure safety of the arthrodesis site. Functional recovery was objectively monitored using the Modified Iowa Level of Assistance Scale (mILOA), which guided the progression of mobility training. Nursing-led rehabilitation focused on improving bed mobility, sitting balance (figure A3), assisted standing (figure B3), and guided ambulation using a walker (figure C3&D3). By postoperative day five, the patient was able to sit independently and initiate partial weight-bearing ambulation under supervision.

Patient education constituted an essential component of nursing care, including instruction on activity limitations, safe use of assistive devices, limb protection strategies, wound care, and home exercise programs. Education aimed to enhance self-efficacy, reduce the risk of reinjury, and support long-term functional adaptation following knee arthrodesis. Overall, the integration of structured early mobilization, evidence-based wound management, objective functional assessment, and patient education resulted in stable wound healing, absence of postoperative complications, and meaningful functional improvement during the early recovery phase.

Ethical consideration

The patient provided the present document constitutes a signed form of informed permission for the gathering and application of medical data pertaining to this case, with signed copies of the consent form retained for documentation purposes. All authors granted their permission to for their work to be publish, and the patient provides written informed consent to publish the details of their medical care and any associated photographs.

RESULTS

Follow-Up and Outcomes

Postoperative monitoring demonstrated stable and progressive short-term clinical improvement during the first three weeks following knee arthrodesis. During inpatient care,

daily follow-up focused on wound condition, drainage volume, extremity function, pain control, and response to early mobilization. Drain output decreased consistently from 300 mL on postoperative day one to 150 mL on day three and 100 mL on day four, indicating adequate hemostatic stability without evidence of hematoma or infection.

By postoperative day four, measurable functional improvements were observed, including increased hip range of motion to 45°, improved muscle strength (MMT 3/5), and reduced pain intensity (VAS 3/10). Ankle mobility also improved, supporting readiness for controlled weight-bearing exercises. On postoperative day five, the patient achieved early rehabilitation milestones, including stable sitting, active leg elevation, and standing with walker assistance, reflecting successful implementation of early mobilization following arthrodesis.

Wound care was continued using a combination of gauze and foam dressings tailored to exudate levels. At evaluation on 17 May 2025, the surgical incision extending from the distal third of the femur to the proximal third of the tibia appeared well approximated, with minimal exudate, no seroma, and early signs of epithelialization. Vacuum drains placed at proximal and distal wound sites remained effective, with a sustained downward trend in drainage volume. Subsequent follow-up from 22 May to 10 June demonstrated optimal wound healing progression, characterized by uniform granulation tissue, advancing epithelialization, and absence of infection, dehiscence, or soft-tissue complications (Figure 4). Leukocyte levels normalized by postoperative day six, indicating a controlled inflammatory response.

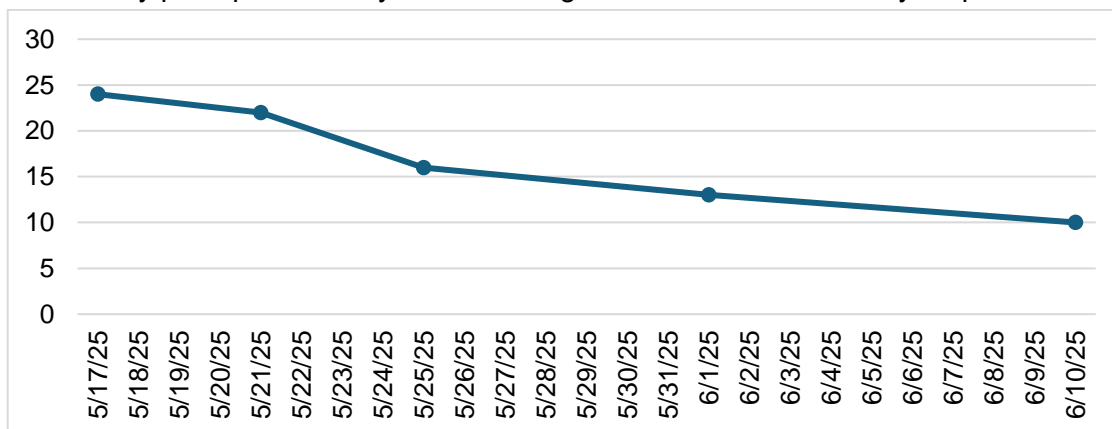


Figure 4. Score Wound Healing

Functional outcomes showed significant improvement, with Modified Iowas Level of Assistance Scale (mILOA) scores reflecting a transition from complete dependence to minimal assistance, particularly in sit-to-stand transfers and early ambulation. Katz Activity of Daily Living (ADL) scores also improved from 4/6 toward greater independence by the end of the short-term follow-up period. No major postoperative complications, including wound infection, fixation failure, or deep vein thrombosis, were observed.

It should be emphasized that the outcomes reported in this case represent short-term postoperative and rehabilitation results. Long-term oncologic follow-up has been planned but was not yet available at the time of reporting, including scheduled oncologic evaluation one month after discharge to assess local recurrence through clinical examination and imaging, as well as continued rehabilitation follow-up at the hospital and community health services to monitor long-term functional recovery and arthrodesis stability. In addition to

inpatient monitoring, post-discharge follow-up was conducted through telemonitoring to ensure safe continuation of physical activity at home. Regular monitoring via video calls and WhatsApp focused on visual wound assessment (figure 5), daily activity tolerance, and response to ongoing mobilization. detection of inflammatory signs, such as redness, increased pain, excessive oedema, abnormal discharge, or bleeding related to physical activity. During home monitoring, patients received ongoing guidance on activity modification, limb protection, and prompt care, early detection of post-discharge complications, and safe implementation of early mobilization during the initial home-based rehabilitation phase following knee arthrodesis. No major postoperative complications including wound infection, fixation failure, or DVT—were observed. Overall, these findings demonstrate that a multimodal approach integrating definitive surgery, structured early mobilization, mILOA-based rehabilitation, and modern wound care resulted in optimal wound healing, extremity stability, and significant functional recovery in this patient following knee arthrodesis for chondrosarcoma. The patient was instructed to report and demonstrate the surgical wound to allow early.



Figure 5. Progress of wound healing following knee arthrodesis using the Bates-Jensen wound assement tools

DISCUSSION

Chondrosarcoma is a malignant neoplasm originating from cartilaginous tissue. Although its growth is generally slow, the tumor can cause extensive local invasion and significant destruction of surrounding structures. The risk of local recurrence and systemic spread increases in parallel with the histological grade of the tumor.¹¹ In this 40-year-old male patient, radiological findings revealed a lytic lesion involving the epimetaphysis to metaphysis of the proximal tibia, accompanied by multiple chondroid matrix patterns. The diagnosis was further supported by histopathological features demonstrating hypercellular chondrocytes with pleomorphism, binucleation, and irregular cartilaginous matrix hallmarks consistent with grade 2 chondrosarcoma.

The patient's age is considered unusually young for this diagnosis, as most chondrosarcoma cases occur between 50 and 70 years of age.¹² Presentation at a younger age is more commonly associated with specific subtypes, such as dedifferentiated or mesenchymal chondrosarcoma.¹³ In this case, the patient presented to healthcare services at stage 2 disease without evidence of metastasis, a factor that strongly supported both

surgical decision-making and postoperative recovery. At this localized stage, the tumor burden remains confined, allowing for wide excision with adequate oncologic margins while avoiding systemic disease involvement. Previous studies have demonstrated that patients with localized musculoskeletal tumors experience better functional outcomes and more favorable wound-healing trajectories compared with those with metastatic disease, largely due to lower systemic inflammatory load and preserved regenerative capacity.^{14,15} This clinical context provided a strong foundation for successful limb-salvage surgery using knee arthrodesis and enabled the safe implementation of early rehabilitation strategies.

Early mobilization in this patient was considered safe due to the exceptional biomechanical stability provided by the plate–cement arthrodesis construct. Unlike conventional fixation methods or joint-preserving reconstructions, knee arthrodesis intentionally eliminates joint motion to create a rigid mechanical unit between the femur and tibia. The use of a long plate, multiple screws, and polymethyl methacrylate (PMMA) bone cement provides high initial stability and uniform load distribution, allowing the construct to tolerate low-level mechanical stimulation during the early postoperative phase without increasing the risk of fixation failure.^{10,16} This stability was reflected in the patient's clinical progression by postoperative day four, with improvement in hip range of motion to 45°, increased muscle strength (MMT grade 3/5), reduction in pain intensity from 5/10 to 3/10, and a decrease in drain output to 100 mL. These findings are consistent with evidence showing that early isometric exercise preserves muscle protein synthesis following major surgery and that early exercise is a key component of fast-track and enhanced recovery protocols in lower-extremity surgery.

The wound-healing process lasted 24 days (17 May–10 June 2025), beginning with postoperative inpatient care and progressing through home-based follow-up. Overall, healing demonstrated an excellent response consistent with the physiological phases of wound recovery following major lower-extremity surgery. In Inflammation (Days 0–2), During the first two days, the wound remained in the inflammatory phase, characterized by mild edema and progressively decreasing exudate. This phase typically lasts 48–72 hours. In this case, early reduction of exudate indicated a well-controlled inflammatory response without signs of infection, consistent with evidence showing that early exudate stabilization and absence of erythema signal a healthy inflammatory phase and reduced infection risk.^{17,18} Other studies report that resolution of mild inflammation within 48–72 hours strongly predicts successful healing trajectories.^{19,20}

During the second week, epithelialization increased markedly. Physiologically, days 7–14 represent the peak phase of keratinocyte migration and collagen deposition, facilitating rapid closure of the wound surface. Studies indicate that consistent epithelialization during week two correlates with a 60% reduction in postoperative wound complications.²¹ further report that surgical incisions demonstrating substantial epithelialization by days 10–14 typically progress into remodeling uneventfully.²² Beyond functional recovery, early mobilization also contributed meaningfully to wound healing. Controlled muscular activity enhances peripheral blood flow, improves tissue oxygenation, and accelerates granulation tissue formation.^{23–25} These physiological benefits were complemented by optimal wound management, including the use of vacuum drainage to prevent fluid accumulation and dead space both critical factors in reducing the risk of hematoma and wound dehiscence.^{26,27} The application of high-absorbency foam dressings further supported wound healing by

maintaining moisture balance, promoting epithelialization, and improving collagen organization.²⁸

Through this integrated approach, the patient achieved key functional milestones by postoperative day five, including stable sitting, active leg lifting, and initiation of assisted standing with a walker. In contrast to reports of delayed mobilization contributing to wound complications in oncologic lower-extremity surgery due to limited soft-tissue coverage and compromised vascularity.^{29,30} Close functional monitoring using the Modified Iowa Level of Assistance Scale (mILOA) played a critical role in evaluating rehabilitation progress and supporting timely discharge planning. The novelty of this case report lies in the deliberate integration of structured early mobilization, systematic wound monitoring using the Bates–Jensen Wound Assessment Tool (BWAT), and functional assessment with mILOA in a patient with chondrosarcoma following knee arthrodesis. This combined approach provides a comprehensive, objective framework linking wound healing status with functional recovery during the early postoperative period. Such an integrated strategy remains rarely reported in orthopedic oncology rehabilitation, particularly within resource-limited settings where advanced monitoring technologies may be unavailable. By demonstrating the feasibility and clinical utility of this approach, the present case highlights a pragmatic, multidisciplinary rehabilitation model that may be applicable in similar low-resource clinical contexts and represents a clear contribution of this study to the existing literature.

Strengths of This Case

Several strengths highlight the robustness of the clinical management: Detailed longitudinal documentation of postoperative mobility, muscle strength, pain, and wound progression created a clear clinical timeline and accurately reflected the patient's functional recovery. Use of validated assessment tools MMT, Modified Iowa Scale, and Katz ADL enhanced reproducibility and allowed comparison with evidence-based recovery standards. Multidisciplinary, patient-centered approach involving surgeons, nurses, and physiotherapists aligns with best practices for managing intermediate-grade chondrosarcoma. Consistency with ERAS principles, where preoperative education, patient engagement, and team adherence to protocol play major roles in recovery paralleling the success documented in this case.

Limitations

As a single-case report, the findings cannot be generalized to all patients undergoing orthopedic oncology reconstruction, and long-term follow-up is required to evaluate oncologic outcomes such as local recurrence or metastasis, as well as the long-term durability of knee arthrodesis. Modifiable patient-related factors, including a history of heavy smoking, delayed medical consultation due to reliance on traditional therapies, and socioeconomic barriers, may have influenced the recovery process, consistent with literature describing prognostic variability in chondrosarcoma. The novelty of this case report lies in the integration of structured early mobilization, wound monitoring using the Bates–Jensen Wound Assessment Tool (BWAT), and functional assessment with the Modified Iowa Level of Assistance Scale in a patient with chondrosarcoma following knee arthrodesis. This integrated approach remains rarely reported, particularly in resource-limited settings, and underscores the potential role of multidisciplinary rehabilitation strategies in supporting functional recovery after complex limb-salvage procedures, warranting further evaluation in larger cohort studies.

CONCLUSION

Overall, this case reinforces evidence that structured early mobilization combined with modern wound care principles can significantly enhance postoperative outcomes following knee arthrodesis for intermediate-grade chondrosarcoma. The integration of precise surgical technique, rehabilitation strategies, and nursing-based wound care provides a practical and effective model for limb salvage particularly relevant in resource-limited facilities where cemented arthrodesis remains a viable reconstructive option. These findings align with current ERAS literature in knee surgery and major arthroplasty, which consistently report reduced hospital stay, decreased opioid use, and improved functional recovery without increased complications

Based on the outcomes of this case, structured early mobilization combined with moisture-balanced wound care should be considered a core component of postoperative management after knee arthrodesis for tibial chondrosarcoma, particularly in resource-limited settings. The use of objective assessment tools such as BWAT and mLLOA is recommended to ensure accurate monitoring of wound healing and functional recovery. Comprehensive patient and family education regarding safe mobilization, home wound care, and long-term functional adaptation is essential to improve adherence and prevent complications. Further studies with larger cohorts are needed to confirm these findings and evaluate long-term functional and oncologic outcomes.

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