

Orthopedic and Traumatology Impacts on Psychological Health Due to Simultaneous Lateral Open-Wedge Varus Osteotomy with Acl Revision: Importance of Coronal Alignment and Stability Restoration to Improve Acl Graft Survival

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Abstract

Introduction: The success and long-term effectiveness of any knee surgery or reconstruction heavily depend on the accurate alignment and positioning of knee components. Therefore, this case report aims to examine the importance of managing sagittal and coronal imbalance to maintain the survival of the graft, especially in cases with deformity and instability in the coronal plane.

Objectives: The primary objective of this case report is to highlight the significance of managing sagittal and coronal imbalance in ACL ruptures with associated deformities and coronal instability.

Methods: A retrospective analysis was conducted on an eighteen-year-old male patient who presented with right knee pain and a history of ACL reconstruction and valgus deformity. The patient underwent a second operation involving osteotomy, ACL revision, and reattachment of the proximal avulsion of the MCL. Physical examination findings and MRI results were evaluated to assess the effectiveness of managing sagittal and coronal imbalance.

Results: The physical examination revealed the presence of valgus deformity, a scar from the first surgery, and no signs of infection, but with no tenderness and limitation of the right knee ROM. MRI indicated a proximal avulsion of the MCL. Following the second operation involving osteotomy and revision of ACL with reattachment of the MCL avulsion, improvements in knee alignment and stability were observed.

Conclusions: The findings of this case report highlight the crucial role of addressing sagittal and coronal imbalance in ACL ruptures with associated deformities and coronal instability. Correcting malalignment alongside ACL repair, particularly in severe cases, can significantly contribute to maintaining the survival of the graft and improving the long-term outcomes of knee surgeries.

Keywords: ACL injury, Sagittal and coronal imbalance, Varus Osteotomy, ACL revision, case report.

1. Introduction

The success of ACL reconstruction relies on a multitude of factors, among which pre-existing deformities play a crucial role. Increased varus alignment and posterior slope contribute significantly to the instability of the ACL-deficient knee joint. Furthermore, these factors increase stress levels on the reconstructed ACL graft, resulting in a higher failure rate of the puzzle piece (Klek & Dhawan, 2019). Based on this background, accurate alignment and positioning of knee components are important for the success and longevity of the postoperative outcome of any knee surgery/reconstruction (Laskin & Beksac, 2006). Proper alignment has been shown to yield greater

stability and improve clinical scores (Lording et al., 2016; Oussedik et al., 2020; Ritter, 2009). However, not every surgeon holistically considers each and every aspect of the knee's component alignment.

2. Objectives

The main goal of this research was to highlight the importance of effectively managing sagittal and coronal imbalance in cases of ACL ruptures with associated deformities and instability in the side-to-side plane. The success and long-term effectiveness of knee surgery or reconstruction rely heavily on accurately aligning and positioning knee components. Therefore, this case report carefully examined how proper alignment impacts the survival of the graft, especially when there are deformities and instability in the side-to-side plane. By focusing on these specific aspects, the research aimed to underscore the significant role that sagittal and coronal balance play in ACL surgeries, emphasizing the need for considering and controlling knee component alignment comprehensively to improve postoperative outcomes. Through a thorough analysis of the presented case and relevant scientific literature, this research sought to emphasize the importance of addressing sagittal and coronal imbalance to enhance the long-term effectiveness and success of ACL reconstruction procedures.

3. Case Report

An eighteen-year-old male patient presented to the orthopaedic outpatient ward with the main complaint of right knee pain. The patient had a history of ACL reconstruction in a previous hospital and had been experiencing valgus deformity since the age of 10 due to playing soccer, but refused to undergo osteotomy. The first reconstruction failed after three months during rehabilitation. Furthermore, the patient had no other chronic illnesses. The physical examination revealed valgus deformity, a scar after the first surgery with no sign of infection, and no tenderness and limitation of the range of motion (ROM) of the right knee, as shown in Figure 1a. X-ray after the first surgery showed no abnormality in the knee, as shown in Figures 1b and 2a. Subsequently, an MRI was performed for further diagnosis, and the results showed a proximal avulsion of the MCL, as indicated in Figure 2b. During the second operation, the patient consented to undergo tibial osteotomy to address the valgus deformity.

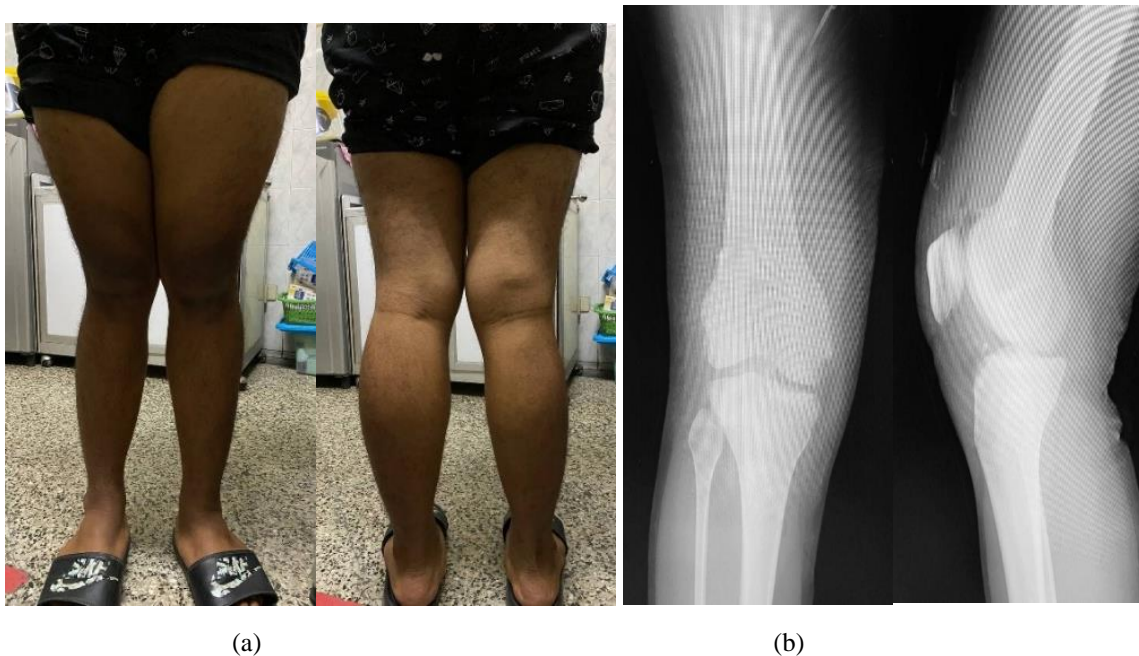


Figure 1. (a) Clinical lower extremity photo before the first surgery; (b) Anteroposterior and lateral radiograph after the first surgery.

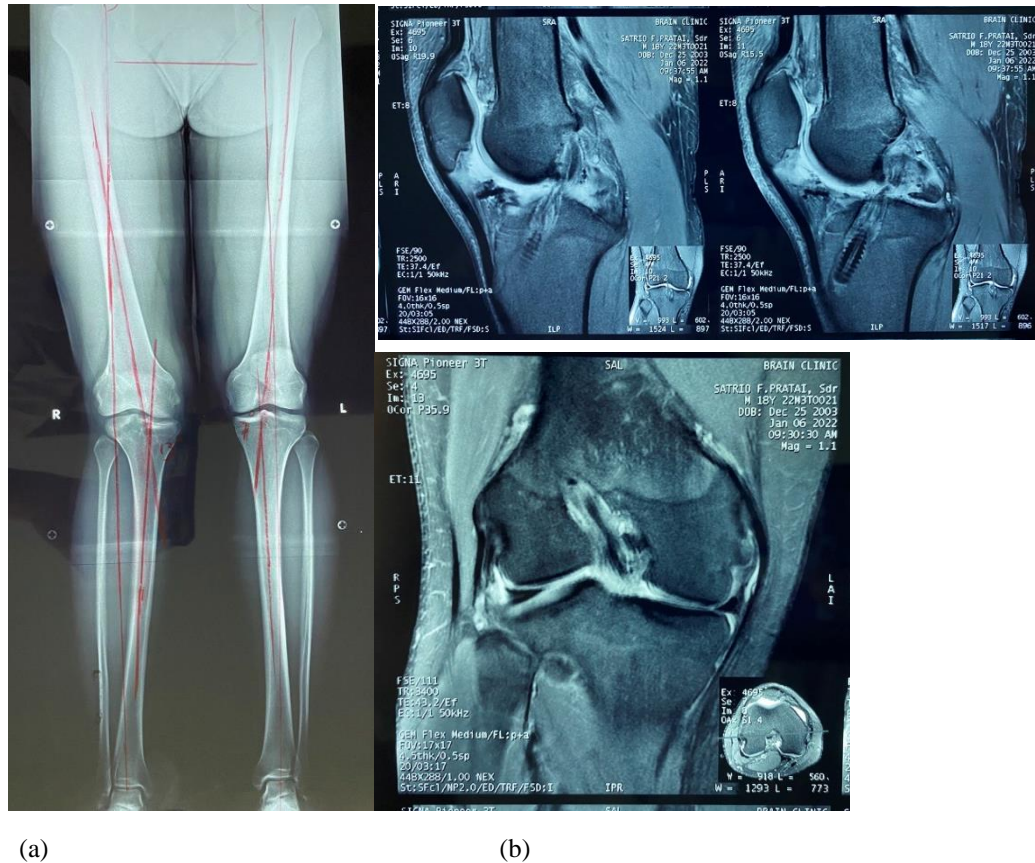


Figure 2. (a) Preoperative standing long leg radiographs; (b) MRI Sagittal view showing ACL graft rupture and also MRI coronal view showing intact PCL.

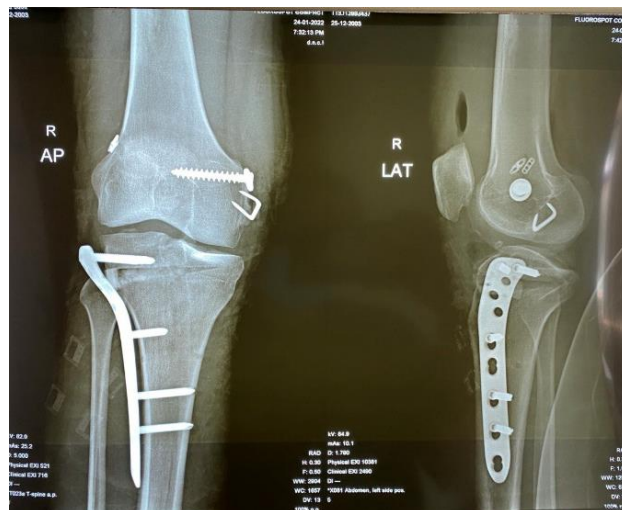


Figure 3. Anteroposterior and Lateral Radiograph after ACL reconstruction and Varus Osteotomy

Results

This study result showed that the sagittal and coronal alignment of the knee significantly influenced joint biomechanics and the stresses experienced by ligaments, which were crucial for resisting forces on the planes. Errors in these alignment planes could lead to ligament re-ruptures.

The coronal plane, especially, played a vital role in reflecting the transmission of weight from the body to the ground, with the mechanical axis of the femur and tibia used as indicators of coronal plane alignment. "Double

varus," a problem in the coronal plane, could be exacerbated by an increase in joint line gapping. Biomechanically, a malalignment of 12 degrees of varus/valgus increased the load on the knee by 78% during extension and 218% during 10o of flexion (Van De Pol et al., 2009). Additionally, the strain on the ligaments increased by 30% compared to normal knee alignment (Withrow et al., 2006).

The sagittal plane has a significant role in the integrity of the cruciate ligaments with posterior tibial slope (PTS) usually used as an indicator (Bernhardson et al., 2019; Dai et al., 2018; Kang et al., 2018). The biomechanical problem resulting from errors in this plane is a shift of the tibia relative to the femur in the intact knee (Giffin et al., 2004). Previous studies had shown that a 10-degree increase in PTS led to greater knee joint moments (Bates et al., 2016). A steeper PTS also increased ACL strain by 75% (Meller et al., 2008).

In this study, the evident problem contributing to the re-rupture of the ACL was the patient's genu valgus, which shifted the mechanical axis far from the center of the knee (Figure 3). Multicenter studies analyzing ACL revision had found that 4% of these patients were directly or indirectly affected by this malalignment (Noyes & Barber-Westin, 2006). ACL revision occurred twice as often in patients with malalignment compared to those without it. Additionally, a higher risk of meniscal injury and medial tibiofemoral arthritis was found (Won et al., 2013). Therefore, it was essential for orthopedic surgeons to emphasize the importance of correcting the patient's knee varus/valgus deformity along with addressing the ACL tear. This approach ensured a long-term positive outcome of ACL repair.

This case report also raised the question of the necessity of performing a protective proximal tibial osteotomy in every ACL reconstruction. Contrary to previous studies, increasing degrees of varus/valgus alignment in the primary ACL rupture did not negatively affect both the function and stability scores (Kim et al., 2011). Therefore, it was concluded that such a double procedure may only be necessary for cases with evident varus/valgus conditions of the knee.

4. Conclusion

In conclusion, this case study provides compelling evidence for the significance of assessing and treating alignment on all planes of the knee, extending beyond ruptures and fractures. The inclusion of tibial osteotomy along with ACL repair is justified in cases where significant malalignment of the knee was present.

Author Contributions:

Conceptualization, M.M.A. and K.D.H.; Case Report, M.M.A.; formal analysis, K.D.H.; writing—original draft preparation, M.M.A.; writing—review and editing, K.D.H. All authors have read and agreed to the published version of the manuscript.

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Ethical review and approval were waived for this study due to the use of data from a single sample. Only written informed consent from patients was required.

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Conflicts of Interest:

The authors declare no conflict of interest

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