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Case Study: Leveraging Wearable Technology for Physiological Modeling in Guiding Return to Play Protocols for Athletes Post-ACL Reconstruction Surgery

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ABSTRACT

There is a clinical need to quantify return to play when assessing athletes' post-surgery. This study aims at developing physiological models to predict recovery time post-Anterior Cruciate Ligament (ACL) surgery in Division 1 Football players by integration of physiological and subjective data. **PURPOSE** Amidst the pressure to excel in top athletic competitions, athletes frequently endure ligamentous injuries, notably ACL tears. Yet, there's no standard method for quantifying return-to-play post-ACL reconstruction, leaving rehabilitation without an objective measure to assess athletes' readiness. Holistic assessment integrating physiological and subjective measurements can facilitate return prediction. **METHODS** This case study evaluates two Division 1 football athletes at various intervals post-surgery, recording physiological (Muscle oxygen saturation (SmO_2), heart rate, and hours of sleep) and subjective metrics (rate of perceived exertion (RPE) and soreness) metrics were recorded during rehabilitation sessions at 1, 3, 5, 6, 9, and 12 months post-surgery. Descriptive statistics and the mean difference of SmO_2 between surgical and contralateral legs was analyzed, along with correlation between subjective measures. **RESULTS** Descriptive statistics showed that the data was non-parametric. Physiological metrics reveal after three months, there is no statistical difference in the mean difference of SmO_2 between legs. Correlation analysis showed that hours of sleep and RPE had a relationship coefficient of -0.72. **CONCLUSION** This study addresses the urgent necessity for quantifying return-to-play metrics post-ACL surgery in Division 1 Football players. Through meticulous recording of physiological and subjective data, significant progress in rehabilitation was observed after three months, evidenced by the absence of statistical difference in the mean SmO_2 of the two legs, a trend exceeding current literature expectations. Subsequent efforts will focus on robust modeling techniques to forecast optimal return-to-play timelines, emphasizing the importance of holistic assessment. These findings contribute to informed decision-making in rehabilitation practices and sports medicine, ultimately enhancing athletes' readiness for competitive participation.