Recent Advancement of 3D-motion Analysis in Sports Rehabilitation: A Narrative Review

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ABSTRACT

In sports rehabilitation, 3D motion analysis involves tracking and analysing an athlete's movement in three dimensions using cutting-edge technology, such as wearable sensors, motion capture structures, and biomechanical modelling. The aim of this review is to quantify the effective use of motion capture and 3D modelling technology to facilitate sports training. Sports rehabilitation has been modified by recent advances in 3D motion analysis, which provide comprehensive view of athletic movement patterns. Therapists may create specialised rehabilitation plans with this technology, which speeds up recovery and decreases the chance of injuries. In the clinic, the Inertial Measurement Unit (IMU) sensors are used together with tests and outcome measurements. The most widely used techniques include smartphones with standard optical cameras and IMUs. Artifical Intelligence (AI) recently emerged as one of the most researched areas of motion analysis technologies in health. It is evident that AI has several types of benefits, such as reductions in time and money and the ability for better patient care, as Machine Learning (ML) reduces illnesses, decision-making, and analysis. ML has been shown to be more effective in medical imaging, wearable technologies, risk prediction, pain phenotype prediction, and decision support when it involves sports injuries and conditions. In sports biomechanics and rehabilitation, the marker-less motion analysis system gives a fast, entirely automatic, and noninvasive technique that can significantly improve research and application From December 2020 to December 2025, a literature search was done using the PubMed, Scopus, and Embase databases. Boolean operators (AND, OR) were used in the search, which included terms like "3D motion," "wearable motion" and "biofeedback." Articles in which recent advancement in 3D motion analysis was discussed or used were included in this review. Non-English and non peer reviewed articles were excluded. 2367 articles found from different database, out of which only five met the inclusion criteria. A comprehensive study proved that motion capture and 3D modelling technologies had a beneficial impact on sports training. According to our findings, the motion recognition methodology of the suggested system can be utilised to monitor the patient's rehabilitation progress and confirm that the physiotherapy exercises are of high quality.

Keywords: Machine learning, Marker-less motion, Motion capture, Wearable electronic device.