Anterior Cruciate Ligament Allografts and Low-Dose Gamma Irradiation: A Systematic Review

Arash Ghoroghi
Department of Trauma and Orthopaedics, Prince Charles Hospital, Wales, UK

Hannah Wise
Department of Trauma and Orthopaedics, Prince Charles Hospital, Wales, UK

Alexandra Warren
Department of General Surgery, Royal Glamorgan Hospital, Wales, UK

Hannah Shaw
Cardiff University School of Biosciences, Wales, UK

Vedran Curkovic
Department of Trauma and Orthopaedics, Prince Charles Hospital, Wales, UK

Abstract:

Anterior cruciate ligament (ACL) rupture is a common injury requiring surgical reconstruction in active patients. Autografts are considered the gold standard due to superior early biomechanical performance, but allografts offer advantages such as reduced operative time and elimination of donor-site morbidity. Irradiation is the primary sterilisation method; however, high doses impair mechanical integrity. Low-dose irradiation has been proposed to preserve graft strength while ensuring sterility. A systematic review was performed using EMBASE, PubMed and Scopus, supplemented with backward snowballing. Cohort and randomised studies comparing low-dose irradiated allografts to autografts in vivo were included. Primary outcomes were graft failure/revision rates, knee laxity (KT-1000/2000, Lachman, pivot shift) and patient-reported measures (IKDC, Lysholm). Eight studies comprising over 10,000 patients were included. Autografts demonstrated lower graft failure rates in younger (<22 years) patients, with revision rates of 10.1% for allografts vs. 2.9% for autografts. In older cohorts, outcomes were largely equivalent. Arthrometric testing showed greater knee laxity with allografts, but this did not consistently translate into differences in patient-reported outcomes. Return-to-sport was faster with autografts, reflecting earlier graft incorporation, while long-term outcomes converged once allografts remodelled. Autografts remain the graft of choice for younger, high-demand patients due to superior early stability and lower revision rates. Low-dose irradiated allografts may represent a viable