

## **EXTENDED REALITY IN SURGERY: INNOVATIONS, APPLICATIONS, AND FUTURE DIRECTIONS**

*Harshitha U Rajmohan & A. Sabarivasan*

*III Biomedical Engineering, Department of Biomedical Engineering, Anna University*

### **ABSTRACT**

*Extended Reality (XR) technologies, including Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), are reshaping the surgical landscape by enhancing visualization, precision, and collaboration in operating rooms. This paper examines the transformative role of XR in surgical practice, highlighting its benefits in preoperative planning, intraoperative navigation, education, and patient engagement. Applications across neurosurgery, orthopaedics, cardiothoracic surgery, oncology, and minimally invasive procedures demonstrate XR's potential to improve outcomes and reduce complications. Despite challenges related to cost, technical complexity, and regulatory standards, XR offers promising avenues for personalized surgical approaches, remote collaboration, and simulation-based risk assessment. Future prospects include integrating artificial intelligence, developing wearable XR devices, and implementing holistic patient care models. By synthesizing current evidence and identifying barriers to adoption, this study underscores XR's capacity to redefine surgical practice and calls for interdisciplinary collaboration to ensure its effective and equitable implementation.*

**KEYWORDS:** *Surgical, Technologies*

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