

# Comparing the Efficacy of Immersive Virtual Reality and Traditional Physical Arthroscopy Simulators in Arthroscopic Training: A Randomized Controlled Trial

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**INTRODUCTION:** Surgical simulation using virtual reality (VR) technology has gained popularity in surgical education. This study aimed to compare the training outcomes and testing performance of an immersive VR arthroscopy simulator (IVR) with a physical arthroscopy simulator.

**METHODS:** Participants meeting eligibility criteria were randomized into four groups: three VR training sessions (VR3), one VR training session (VR1), physical arthroscopy simulator, and no training (Figure). Training metrics and testing performance were evaluated using the global rating scale (GRS) system. Qualitative questionnaires were administered to assess participant experiences and perceptions of the simulators.

**RESULTS:** Out of 38 initial respondents, 29 participants met eligibility criteria and were randomized. The training metrics analysis showed that the VR3 training group exhibited significantly better performance over time compared to the VR1 group. Intragroup analysis within the VR3 group revealed improvements in precision, rotating, periscoping, and object tracking skills from first session to last session ( $p < 0.001$ ). The physical simulator group had significantly better GRS scores in terms of instrumental and camera dexterity compared to the no training group. No other significant differences were found among the four groups in all other components of the GRS. VR3 had a shorter task completion time compared to the VR1 and no training groups. Change in confidence levels did not vary significantly among the groups. The use of the physical arthroscopy simulator was perceived to provide additional benefit and continued learning compared to the VR groups (P-values: 0.039). Participants reported high levels of enjoyment, learning, and understanding across all groups (Table). Strengths and limitations of both the IVR and physical simulators were identified based on participant feedback.

**DISCUSSION AND CONCLUSION:** The findings of this study suggest that a non-anatomic physical arthroscopy simulator shows favorable outcomes compared to VR in various training metrics. However, considering the potential advantages of VR, such as portability and cost-effectiveness, it remains a viable option for arthroscopic training. Future advancements in VR technology and simulation design are crucial to improve the realism and effectiveness of VR arthroscopy simulators, ensuring they can provide comparable training outcomes to their physical counterparts. These findings highlight the potential of VR in surgical education and the need for continuous development in this field.

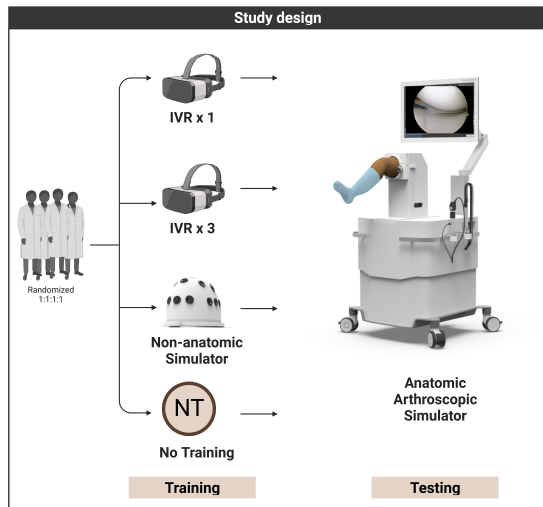


Table – Participant Feedback on VR and Physical Arthroscopy Simulator Using Likert Scales.

Question	Group 1 and 2 – VR	Group 3 – Physical Simulator	P-value
Did you enjoy the learning activity?	4.9	5.0	0.372
Did you learn anything from working with the simulator?	4.5	5.0	0.095
Did you feel that the simulator was easy to understand?	4.3	4.5	0.558
Did you feel that the simulator adequately prepared you for your subsequent knee scope?	3.6	4.3	0.060
What is your overall impression of realism of the simulator?	3.3	4.2	0.055
Do you feel that repeated use of the simulator would provide additional benefit, or continued learning?	3.9	5.0	<b>0.039</b>
Do you feel that an arthroscopy simulator has a role in surgical education?	4.4	4.8	0.079