## Efficacy of Immersive Virtual Reality and Sawbones in Teaching Femoral Intramedullary Nailing: A Randomized Controlled Trial

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The shift towards a competency-based paradigm in surgical education has increased the necessity for surgical skills acquisition in trainees. Various modalities have been used to meet the demand for technical skills development, with bone models and cadavers being the traditional resources employed. Though these are well established modalities, they are limited to use at a specific location and time and employ single use products. The recent development of surgical simulation using virtual reality technology provides a novel approach to technical skills development in surgical trainees. In contrast to traditional methods, VR provides a multi-use, on-demand resource for skills acquisition. However, despite the enthusiasm for VR based surgical skills training, how it compares to traditional modalities is not well understood. Accordingly, this study aimed to compare the efficacy of an immersive virtual reality training program (VR) to traditional SawBones model training (SB) in the performance of femoral intramedullary nailing (IMN). METHODS:

Ten first-year orthopaedic surgery residents from a single institution were evenly randomized to VR and SB training in their first month of residency. The VR training group received VR headsets one week prior to assessment and were allowed to complete a femoral IMN module as many times as they desired, completing this at least once during a supervised session. Participants in the SB group were trained using SawBones models with instructor guidance, inserting a femoral IMN once each. Following these interventions, all participants were assessed on their ability to insert a starting guidewire for a femoral IMN on cadavers under fluoroscopic guidance.

Demographics, prior experiences, and skill-related parameters were compared between the groups. Pre-existing characteristics and confidence levels in femoral IMN performance were collected. Skill acquisition was evaluated through various metrics, including the number of attempts to reach the start point, imaging metrics, Objective Structured Assessment of Technical Skills (OSATS) for femoral IMN insertion, and quality of final starting wire position. Additionally, post-intervention perceived scoring and participant feedback on training modalities were analyzed. **RESULTS:** 

Demographic analysis revealed no significant differences in baseline characteristics, prior experience, and confidence in performance of femoral IMN. The number of attempts and images taken, radiation exposure, and time to start point did not differ between groups (see Table 1). Similarly, no differences in overall and subdomain performance by OSATS were demonstrated (see Table 2). The final radiographic guidewire positions were deemed acceptable for three of the five participants in each group when assessed by three blinded orthopedic surgeons. Post-intervention participant feedback with grading on a Likert Scale demonstrated significantly higher satisfaction in learning (3.8±0.4 vs 4.8±0.4, p=0.01), ease of use (2.8±1.3 vs 4.6±0.5, p=0.02), and global rating (3.2±1.1 vs 4.8±0.4, p=0.02) with SB compared to VR. **DISCUSSION AND CONCLUSION:** 

VR and SB exhibited similar efficacy in training first year orthopedic surgery residents femoral IMN insertion. These findings outline the comparative effectiveness of these educational modalities, highlighting the importance of participant perception and feedback in these teaching methodologies.

	Virtual Reality	Sawbones	P-value
Number of Attempts to Start Point	2.8 (±1.5)	2.4 (±2.1)	0.735
Time to Start Point	6.7 (±1.1)	8.8 (±5.6)	0.441
Number of Images	19.6 (±9.1)	20.2 (±9.6)	0.922
Radiation (Gy⋅cm²)	0.3 (±0.2)	0.3 (±0.1)	0.919

Table 2. OSATS - Femoral IMN Insertion				
	Virtual Reality	Sawbones	P-value	
Respect for Tissue	3.6 (±0.9)	3.2 (±0.8)	0.49	
Time and Motion	2.8 (±0.4)	2.6 (±0.9)	0.67	
Instrument Handling	3.2 (±0.4)	3.4 (±0.9)	0.67	
Knowledge of Instruments	3.4 (±1.1)	4.0 (±1.0)	0.40	
Flow of Procedure	3.6 (±1.1)	3.6 (±0.9)	>0.99	
Knowledge of Specific Procedure	3.4 (±1.1)	3.2 (±1.3)	0.80	
Overall Performance	3.0 (±0.7)	3.2 (±0.8)	0.70	

Values represented as mean ± standard deviation