

Use of Virtual Reality for Increasing Procedural Confidence in Tibial Intramedullary Nail Insertion

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INTRODUCTION: Surgeon self-confidence is a valued trait that may be built over time. A current mainstay of procedural education involves the use of written technique guides produced by device manufacturing companies. While newer technologies are being explored and utilized to improve procedural skills, training competent and confident surgeons remains difficult. In this study, we sought to understand how a trainees' confidence and short-term retention of a common orthopaedic procedure can be improved through virtual reality (VR) training.

METHODS: 17 first year medical students and eight second year medical students were recruited to participate. The 25 total participants were randomly assigned to three comparison groups: a technique guide group (n=8), a VR group (n=8) and a combined VR and technique guide group (n=9). A commercially available Osso VR headset was loaded with a procedural simulation based on a Zimmer Tibial Nail System.1,2 Prior to the study start, all participants took a baseline survey to establish their confidence in tibial nail insertion. Participants also took a quiz prepared by a senior resident to assess their knowledge of the procedural steps. All three groups were then given a preparation period of 10-14 days. The technique guide group used only the technique guide and recorded time spent reading the guide. The VR group underwent 3 VR-based training sessions, while the combined group underwent 3 VR-based training sessions and could utilize the technique guide as much as desired over the 10-14 day period. Following this prep period, participants completed the same confidence survey and procedure quiz as before. Retention was assessed 3 weeks after completion of training. All collected data were blinded and analyzed by a separate researcher unaware of group allocation. All statistical analyses and data collection were performed using IBM SPSS Statistics, Version 25 (IBM Corp, Armonk, NY, USA) with significance set at 0.05.3 Nonparametric Kruskal-Wallis and Mann-Whitney U, and chi-square tests were used to analyze continuous, ordinal, or categorical variables. This study received IRB approval.

RESULTS SECTION: There was no significant difference in baseline confidence, comprehension of procedural steps, or total preparation time in any group (p>0.05) (**Table 1**). After the preparation period, procedural knowledge increased significantly in the VR alone and combined group (p<0.001 and p<0.001, respectively) (**Table 2**). Self-reported knowledge of steps (out of 10) was higher in the VR group and combined group when compared to the technique guide group (p=0.012, p=0.01, respectively). Confidence in performing the procedure with the compact bone model was significantly increased in the VR and combined group compared to the technique guide group (p=0.019, p=0.006). Post-preparation short-term retention of procedural steps was also significantly increased in the VR and combined group compared to the traditional technique guide group (p=0.011, p=0.009).

DISCUSSION: Procedural confidence was significantly higher in trainees that utilized integrated VR simulation for preparation for a common orthopaedic procedure, the insertion of an IM tibial nail. Our data emphasize that trainees' confidence and short-term retention of a procedure can be improved through virtual reality simulation. This improved confidence may foster an increase in autonomy and improved trainee education.

SIGNIFICANCE/CLINICAL RELEVANCE: VR simulation would likely benefit orthopaedic surgery trainees on various procedures and should be incorporated as an adjunct into more training programs.

REFERENCES: [1] Osso VR - Virtual Reality Surgical Training Platform. at <<https://ossovr.com/>>. [2] Zimmer ® Natural Nail ® System Tibial Nail Surgical Technique. [3] IBM: SPSS Statistics. at <<https://www.ibm.com/products/spss-statistics>>.

IMAGES AND TABLES:

Pre-Study Procedural Knowledge and Confidence					
	Quiz (%)	Comfort with steps (out of 10)	Comfort with bone model (out of 10)	Comfort on patient with attending (out of 10)	Comfort on patient without attending (out of 10)
Technique Guide Group (n = 8)	33.3	1.83	1.67	1.67	1.67
Virtual Reality Group (n = 8)	39.7	1.13	2.00	1.88	1.00
Virtual Reality and Technique Guide Group (n = 9)	33.3	1.44	2.00	1.89	1.00

Table 1. Baseline procedural knowledge and confidence assessed across several parameters.

Post-Preparation Procedural Knowledge and Confidence					
	Quiz (%)	Comfort with steps (out of 10)	Comfort with bone model (out of 10)	Comfort on patient with attending (out of 10)	Comfort on patient without attending (out of 10)
Technique Guide Group (n = 8)	33.3	1.83	1.67	1.67	1.67
Before vs. After p-value*	.086	.040	.021	.020	.015
Virtual Reality Group (n = 8)	39.7	1.13	2.00	1.88	1.00
Before vs. After p-value*	< 0.001 ⁻³	< 0.001	< 0.001	< 0.001	.024
Virtual Reality and Technique Guide Group (n = 9)	33.3	1.44	2.00	1.89	1.00
Before vs. After p-value*	< 0.001 ⁻³	< 0.001	< 0.001	< 0.001	< 0.001

* P-values compare pre-procedural versus post-procedural scores within each group.

Table 2. Post-preparational procedural knowledge and confidence across several parameters.