INTEGRATING SIMULATION AND VIRTUAL REALITY IN AESTHETIC MEDICINE EDUCATION: IMPROVING SAFETY AND SKILL PROFICIENCY IN A PRELIMINARY STUDY

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INTRODUCTION

Aesthetic medicine is a field that requires a high level of technical skill, precision, and ongoing training to ensure safe and effective treatments. Despite the growing complexity of aesthetic procedures, there is currently no established use of simulation-based training tools in this specialty, unlike in many other areas of medicine where simulators are widely employed to enhance clinical skills [1-5] . This study aims to pioneer the evaluation of simulators as educational tools in aesthetic medicine, with the goal of demonstrating their potential in accelerating skill acquisition, improving procedural accuracy, and reducing the risks associated with early-stage practice on real patients. By drawing on evidence from simulation effectiveness in other medical specialties, this work seeks to establish a foundation for the use of simulation devices in aesthetic medicine education and assess their impact on the competence and confidence of practitioners.

AIMS

This study aims to evaluate the effectiveness of a simulation-based training device in enhancing the technical and practical competencies of physicians and dental practitioners enrolled in aesthetic medicine master's programs, specifically in the application of botulinum toxin (botulinum therapy). By providing a controlled and risk-free environment, the simulator is intended to support practitioners in mastering essential injection techniques, optimizing dosage accuracy, and improving procedural safety, thus preparing them for real-world clinical scenarios with greater confidence and skill.

MATERIALS AND METHODS

47 students of both genders (31 females, 16 males) have been enrolled in the longitudinal study but only 36 participants were considered eligible. Each participant compiled a questionnaire to quantify their improvements in the understanding on how to perform safely and correctly the botulinum injection procedure (practical skill) andanatomical knowledge related to the key anatomical structures strictly related to the correct execution of botulinum shots in the facial area. The questionnaire consisted of 21 randomly presented questions at 3 distinct time points: t0 (before training), t1 (post-theoretical session), and t2 (post-practical session utilizing the simulator). Participants were randomly assigned into four groups, each of which group followed the same testing protocol. The theoretical session was conducted using an immersive environment where trainers highlighted key anatomical structures critical for performing botulinum toxin injection procedures Additional guidance was provided on crucial aspects specific to botulinum toxin injections for aesthetic applications. The training session was performed by all participants assisted by "naive" engineers to prevent any technical problem would have risen and to avoid any bias to be introduced that would have affected the quality of the execution of the task. Questionnaire mean results were compared between the different time-points and in particular: t0-t1, t1-t2 and t0-t2. The statistical analysis was conducted using a pairwise Wilcoxon signed-rank test with Bonferroni Correction.

Fig. 1 Set up and environment of the study.

Fig. 2 VR Anatomical Lecture

Fig. 3 BeautySim Simulator for Botulinum Injection Procedure

RESULTS

Data showed a statistical significant improvement ($p-value = 0.01074$ at T0−T1, $p - value = 0.00061$ at T1−T2 and $p - value = 9.8 \times 10-6$ at T0−T2) for each comparison revealing a great improvement in mean score during the training session demonstrating the efficacy of the proposed innovative methodology. The post-hoc power analysis (α=0.05, dz=0.5dz = 0.5) confirmed a power level of 81.2% indicating the study was robust.

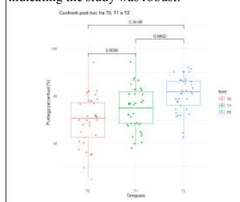

Fig. 4 Results of the comparison of mean improvement in questionnaire score at the three different timepoints (T0, T1, and

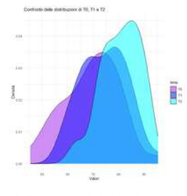

Fig. 5 Comparison of the distributions at the three different timepoints (T0, T1, and T2)

CONCLUSIONS

The use of virtual reality and simulation-based devices in aesthetic medicine has demonstrated significant improvements in practitioners manual skills and theoretical knowledge. By offering a controlled, risk-free environment, these tools allow practitioners to refine essential techniques and gain hands-on experience with virtual patients, minimizing clinical risks and enhancing procedural confidence. This study suggests that simulation technology holds substantial potential to become an integral part of aesthetic medicine education, aligning with broader medical training trends. As these devices continue to evolve, they are likely to gain an increasing presence in educational settings, offering a safe and effective means for practitioners to advance their skills and prepare for real-life clinical applications.

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