

# ADVANCING SURGICAL TRAINING



The wormhole methodology for training surgeons safely and efficiently.

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With a growing demand for eye surgeons and varying educational quality worldwide, traditional surgical training methods are no longer sufficient. Technological advances such as virtual simulators and innovative approaches are revolutionizing the field. Our wormhole methodology, for example, allows us to train surgeons more quickly, efficiently, and safely—ultimately benefiting patients.

## THE WORMHOLE THEORY

In physics, the wormhole theory suggests that a theoretical passage through space-time could create shortcuts for long journeys across the universe. We adapted this concept to surgical training. By integrating active learning with simulation, we have shortened the time required to achieve surgical proficiency while promoting a continuous improvement mindset. We use adult learning methodologies within high-fidelity virtual reality simulation paired with close expert surgical mentorship.

Our approach divides the essential surgical skills into three categories: motor, cognitive, and mindset. Specific training in each is required to attain proficiency in surgery swiftly and cost-effectively.

## MOTOR SKILLS

Motor skills involve the ability to control one's muscles and coordinate one's movements. In surgery, motor skills are crucial for completing tasks such as making incisions, suturing, manipulating

surgical instruments, and performing delicate dissections.

## Precision

Surgeons must execute small, accurate movements, particularly when working with delicate tissues and structures. Excellent hand-eye coordination and spatial awareness are required.

## Dexterity

Surgeons need to use their hands and fingers skillfully to perform complex tasks such as suturing and handling surgical instruments. Advanced fine motor skills and manual dexterity are required.

## Strength

Surgeons must exert force using surgical instruments, especially when retracting tissue or cutting through bone. Adequate muscle strength and endurance are essential for these activities.

## Endurance

Surgeons often perform operations over extended periods. Consequently, strong endurance is necessary for them to maintain motor precision.

## COGNITIVE SKILLS

Cognitive skills encompass the mental abilities used in thinking, reasoning, and problem-solving. In surgery, these skills are vital for tasks such as making a diagnosis, developing a treatment plan, managing unexpected complications, and communicating effectively with patients, colleagues, and other health care professionals.

## Problem-Solving

Surgeons must swiftly and effectively identify and resolve problems. Unexpected complications can occur at any time during surgery. Surgeons must think quickly and devise immediate solutions to address these challenges.

## Critical Thinking

Analyzing information and making well-informed decisions is crucial for surgeons. Critical thinking is particularly important when determining patient care strategies, such as choosing a surgical approach or managing complications.

## Decision-Making

Surgeons often face high-pressure situations that require timely and decisive action. Examples include significant bleeding and unexpected surgical challenges. The ability to make decisions under pressure is essential.

## Communication

Effective communication with patients, colleagues, and other health care professionals is crucial for discussing the risks and benefits of surgery, obtaining informed consent, and coordinating care.

## MINDSET SKILLS

Mindset skills are the mental and emotional capabilities that enable individuals to manage their thoughts, feelings, and behaviors effectively. In surgery, these skills are crucial for maintaining focus, staying calm under pressure, making swift decisions, and performing optimally.

### Focus

Surgeons need to concentrate on the task at hand and block out distractions. This is important for maintaining precision and accuracy during surgical procedures.

### Calmness

Surgeons must remain calm under pressure, such as when unexpected complications arise. Composure promotes clear thinking and sound decision-making.

### Resilience

Surgical careers are demanding and challenging, requiring surgeons to recover quickly from setbacks. Resilience enables surgeons to learn from their mistakes and execute their professional duties competently.

### APPLYING OUR METHODOLOGY

Our combination of technology, methodology, and mentorship can accelerate surgical learning. With deliberate practice, trainees can quickly achieve technical proficiency and excellence. Wormhole methodology also allows us to foster an environment of situational adaptability in adverse surgical scenarios without the occurrence of real-life complications.

We are currently applying this methodology to more than 50 colleagues and are in the process of publishing our results. Our students have provided positive feedback through questionnaires, indicating they have gained confidence in their ability to manage complex cases and complications effectively. According to trainers at an institution in Latin America, students trained with the wormhole methodology have become “smarter in the eye,” with reductions in complication rates and surgical times and significant improvements in communication skills after simulated surgical training. Trainees have also

demonstrated a better understanding of instructions and have automated many skills before entering the OR.

We presented two studies at the 2023 ESCRS Annual Meeting in Vienna.<sup>1</sup> The first assessed the impact of mentor-guided training using a virtual reality simulator and simulated surgery with 3D-printed artificial eyes on cataract surgical performance among trainees and early-stage consultants. The evaluation was conducted using real patient cataract surgical videos, both before and after the simulation training. These videos underwent a blinded review by surgical experts and were graded using validated metrics such as the ICO-Ophthalmology Surgical Competency Assessment and Non-Technical Skills for Surgeons. Surgeons from countries such as Mexico, the United States, Argentina, Ecuador, Honduras, El Salvador, Barbados, Peru, Colombia, Brazil, and Uruguay participated. They were 35 years of age on average (standard deviation, 2.1), with a sex distribution of 48% male and 52% female. Both groups demonstrated statistically significant ( $P < .05$ ) improvements in mean ICO-Ophthalmology Surgical Competency Assessment and Non-Technical Skills for Surgeons scores in both pre- and postsimulation evaluations.

A second study, involving the same participants, explored the effects of simulated surgical training on their knowledge and confidence concerning anterior vitrectomy.<sup>1</sup> The training was divided into three areas: psychomotor skills, cognitive training, and mindset skills. A questionnaire was administered before and after the training. Expert mentor-surgeons guided the participants through both methods of simulated learning and employed validated teaching methodologies based on adult learning theories. Both

groups demonstrated a statistically significant improvement ( $P < .05$ ) in mean scores on pre- and posttraining questionnaires, affirming the effectiveness of our mentor-guided, simulation-based training approach in enhancing surgical performance and confidence.

### CONCLUSION

The wormhole methodology is allowing us to accelerate surgical learning, enhance trainee confidence, reduce the time required to achieve competence, and improve the quality of surgeons. Integrating virtual simulators, simulation activities, and close expert mentorship can revolutionize the training of eye surgeons, improve patient safety, and use resources more efficiently. ■

1. Ferreira I. Virtual reality simulation and 3D-printed surgical models improve the knowledge and confidence to perform anterior vitrectomy of trainees and consultants within their first two years of practice. Presented at: ESCRS 2023 Congress; September 8-12, 2023; Vienna, Austria.

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