



Surgery Training, Next Level

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VOXEL-MAN ENT is a unique simulator for surgery training. It combines the modules **Tempo** for temporal bone drilling, **Sinus** for endoscopic sinus surgery and **My Cases** for creating your own training cases. Based on virtual reality and robotics, it provides a look and feel close to the real intervention. With **3D Printing**, you can create physical models of your digital surgical site.

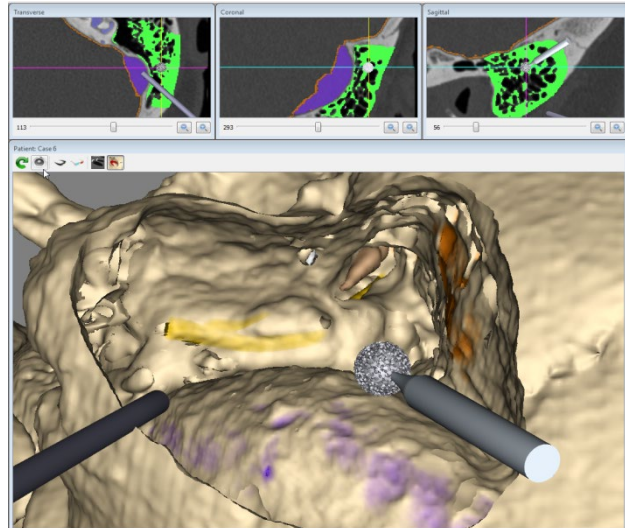
VOXEL-MAN ENT is ideally suited to gain a thorough understanding of the surgical anatomy and approaches in a safe environment. All procedures can be practiced as often as needed, and the costs for a surgical training lab can be significantly reduced. The training simulator features one- or two-handed operation of the instruments, predefined tasks, automatic skills assessment, visualization of learning curves, video capture, online updates, and much more. Its benefits are shown by various independent validation studies.



VOXEL-MAN Tempo – Temporal Bone Drilling

VOXEL-MAN Tempo is a training simulator for surgical access to the complex and vulnerable structures of the middle ear. Patient and instruments are modeled in high resolution inside a computer and visualized on a 3D screen. The handpiece is represented by a haptic device. With our patented haptic simulation, it provides a highly realistic tactile feedback.

Surgical instruments include a selection of metal and diamond burs of different sizes, which are activated by a foot pedal. A suction allows for two-handed training. A virtual surgical navigation system is permanently tracking the movements of the instruments.



Training Cases, Tasks, and Skills Assessment

VOXEL-MAN Tempo offers a set of predefined training cases of the middle ear, with different anatomy and pathology. All are based on high-resolution CT data of real cases. Structures at risk such as facial nerve, tympanic chord, vestibular labyrinth, cochlea, auditory ossicles, carotid artery, sigmoid sinus and dura are highlighted. An optional support function provides automatic alerts when the trainee is approaching critical structures.

As a key element, the simulator includes a number of predefined tasks such as exposure of the sigmoid sinus, the short process of the incus or the facial nerve. An automatic skills assessment provides an immediate and objective feedback of the trainee's performance. Difficulties can thus be identified and the trainee can concentrate on them. An automatic video capture of the session provides additional insights. Instructors may visualize learning curves of individuals and groups to monitor and compare progress over time.

	Score	
Task Fulfillment		
Score for correctly removed tissue.	80	✓
Injuries		
6 injuries of external auditory canal wall	-30	✗
2 injuries of chorda tympani	-10	✗
Instrument Handling		
Efficiency		
time used: 04:44 [min]	3	✓
Result	43	✗

VOXEL-MAN ENT Surgery Simulator

VOXEL-MAN My Cases – Use Your Own Data

The **VOXEL-MAN My Cases** module allows you to upload your own clinical or research data from CT or CBCT and create your own training cases. Within just a few minutes, the system provides a bone model that is ready for drilling. The 3D anatomy may be further enhanced with structures at risk which can be identified using an advanced interactive segmentation approach. Your models may thus reach the same functionality as the predefined training cases.

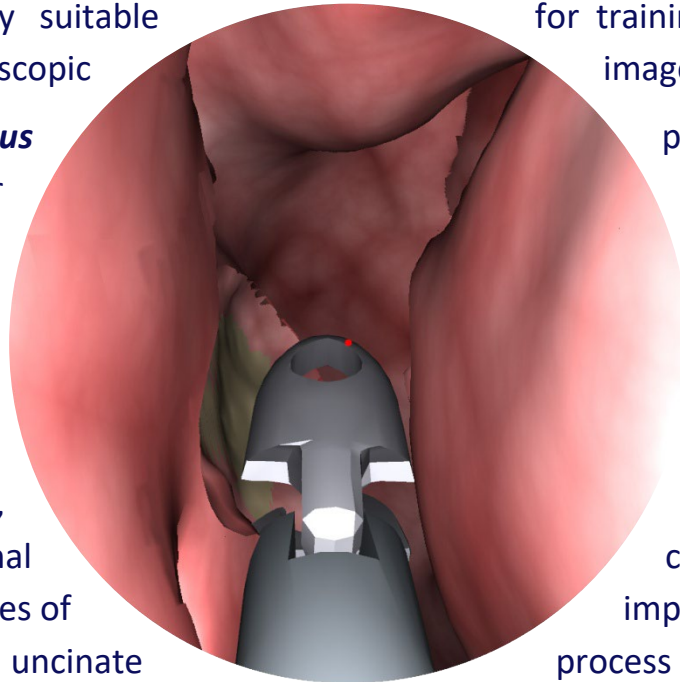


VOXEL-MAN Sinus – Endoscopic Sinus Surgery

VOXEL-MAN Sinus is a simulator for training of endoscopic sinus surgery. It allows for simultaneous handling of the endoscope and a surgical instrument, and is especially suitable for training of orientation based on endoscopic images.

VOXEL-MAN Sinus

and angular various instru- Blakesley debrider. risk such as optic nerve, ethmoidal cells, and internal highlighted. Names of such as the uncinat process are displayed when the endoscope is aiming at them. A virtual surgical navigation system provides additional cross-sectional CT images.



provides straight endoscopes and instruments such as forceps and a Structures at periorbita, optic chiasm, olfactory bulb carotid artery are important landmarks

Housing

VOXEL-MAN is available with an optional housing. Two arm rests and an electrically adjustable height ensure a realistic and comfortable working position. **Tempo**, **Sinus** and **My Cases** modules may be combined as needed.



Advantages

- Reduced costs for surgical training lab
- No disposable materials
- Safe training environment
- Training of surgical approaches and manual dexterity
- Easy access at any time
- Particularly beneficial for junior residents
- Predefined training cases with natural variability and pathologies
- Objective skills assessment
- Authoring of training cases and tasks
- Independent validation studies

Features

- Simultaneous handling of drill and suction, or endoscope and instrument
- Drilling with realistic force feedback (U.S. Patent no. 8,396,698)
- 3D display and glasses
- Superior image quality
- Metal and diamond burs with matching haptics and sound
- Foot pedal
- Surgical navigation
- Visualization of learning curves
- Video capture
- Online software updates and remote service

The properties described refer to different modules, some of which may be optional.

Validation Studies

“Technical skills in mastoidectomy surgery can be acquired during even brief practice on the VR temporal bone simulator” – Laryngoscope

“Our results suggest that VR simulation offers a potential solution to the challenge faced by program directors in delivering effective surgical training in otology” – Otology & Neurotology

“These results indicate the utility of computerised temporal bone simulators in the training of novice surgeons” – The Journal of Laryngology & Otology

“Other commonly expressed opinions were that the simulator was an excellent aid to learning the three-dimensional ‘operative’ anatomy that is clearly integral to competent mastoid surgery” – Annals of The Royal College of Surgeons of England

Full references are available at www.voxel-man.com/validation-studies/

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