Virtual reality for neurosurgical planning

- Training in Endoscopic Endonasal Neurosurgical Procedures: A Systematic Review of Available Models
- Utilizing virtual reality for resection of recurrent ventral, extramedullary cervical meningioma
- Neurosurgical training model in bovine brain for resection of intraaxial tumors
- Intraoperative Utilization of Preoperative Virtual Reality Surgical Simulation
- Simulation tools in neuro-oncological surgery: a scoping review of perioperative and training applications
- Retraction Note: Integration of virtual reality in neurosurgical training and planning: current developments
- Biopsy location and tumor-associated macrophages in predicting malignant glioma recurrence using an in-silico model
- PreVISE: an efficient virtual reality system for SEEG surgical planning

Neurosurgical planning appears to be the fundamental pillar when preparing for any neurooncology intervention [1)]

Neurosurgical training has traditionally involved a steep learning curve that requires extensive practice and exposure to a wide range of procedures. The use of virtual reality technology has revolutionized the way surgical training is conducted, making it more accessible, safe, and efficient. Virtual reality technology provides trainees with an opportunity to develop their skills in a simulated environment that replicates the complexities of a real surgical procedure. It provides a platform for trainees to practice the necessary skills required for surgical procedures before they operate on real patients. Training One of the most significant advantages of virtual reality technology in neurosurgical training is its ability to provide a realistic environment that closely mimics the complexities of a real surgical procedure. The technology allows trainees to simulate various surgical procedures, such as craniotomies, endoscopies, and tumour resections, in a controlled and safe environment. Trainees can practice the necessary skills repeatedly and receive real-time feedback on their performance, enabling them to refine their technique and build their confidence. 3D Models The use of virtual reality in neurosurgical planning has become increasingly popular over the years. It allows surgeons to create 3D models of the patient's brain, allowing them to visualize the complex structures and plan the surgical approach. This technology has been particularly useful in the treatment of brain tumours, allowing surgeons to accurately locate and remove tumours without damaging surrounding healthy tissue. Pre-operative planning Virtual reality technology has also proved useful in pre-operative planning. It allows surgeons to visualize the anatomy of the patient's brain and plan complex surgical procedures with precision. Surgeons can explore different surgical approaches and simulate various scenarios to determine the most optimal surgical plan for each patient. This approach has been particularly useful in complex neurosurgical procedures such as aneurysm clipping and skull base surgeries. The use of virtual reality technology in neurosurgical training and planning has several potential benefits for patients. It may help reduce the risk of surgical complications, shorten operating times, and lead to better patient outcomes. Additionally, virtual reality technology may help reduce the cost of healthcare by minimizing the need for expensive surgical equipment and reducing the number of post-operative complications. Challenges • While the use of virtual reality technology in neurosurgery is still in its infancy, it has enormous potential to revolutionize the field. However, it is important to note that virtual reality technology should be used as a complement to traditional training methods rather than a replacement. The use of virtual reality technology should be combined

with hands-on surgical training to ensure trainees acquire the necessary skills and experience required to perform surgical procedures safely and effectively. • One of the key challenges in using virtual reality in neurosurgery is the cost of the technology. However, as the technology becomes more widespread and advances in computing power and software development continue, the cost is likely to decrease, making it more accessible to a wider range of healthcare providers. • Another challenge is ensuring that the virtual reality simulations accurately represent the actual surgical environment. This requires careful planning and development, as well as ongoing validation and verification to ensure that the simulations are accurate and reliable. Conclusion Virtual reality technology has also been used to improve patient outcomes. By using virtual reality to plan surgeries, surgeons can reduce the risk of complications and ensure that surgeries are more successful. In addition, virtual reality technology can help patients understand their condition and the proposed surgical approach, improving their overall experience and reducing anxiety. The use of virtual reality technology in neurosurgical training and planning has immense potential to transform the field. It provides an opportunity for trainees to acquire skills and experience in a safe and controlled environment and enables experienced surgeons to plan complex surgical procedures with precision. As the technology continues to evolve, it is likely to become an increasingly essential tool in neurosurgery, leading to improved patient outcomes and better healthcare outcomes [2)]

Neurosurgical procedures in neurooncology require the neurosurgeon to carry out a detailed and individualized study of the preoperative images of each case. Historically, this analysis has been referred to as neurosurgical planning and has been performed by studying a stack of two-dimensional images. Continuous development and technological advances have allowed this stack of images to become a combination of different three-dimensional structures, making their analysis more intuitive.

The original protocol of González-López et al allows for the implementation of all these three-dimensional objects in a virtual reality space where they can be modified (changes in size, position, transparency, perspective, etc.) so that neurosurgeons can study each case individually and from a much more immersive perspective to develop much safer neurosurgical plans. In addition, these objects can be printed, forming an exact replica of the anatomical structures of the patient to be operated on so that the surgical team can perform an advanced simulation before the actual surgery. Further studies will be needed to assess the usefulness and accuracy of these technologies [3)].

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2)
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3)
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