Author’s response to reviews

Title: Virtual reality technology for teaching neurosurgery of skull base tumor

Authors:
Xuefei Shao (shaoxuefei@wnmc.edu.cn)
Quan Yuan (wuhuyuanquan@163.com)
Daqing Qian (19850003@wnmc.edu.cn)
Zheng Ye (20160039@wnmc.edu.cn)
Gao Chen (624667118@qq.com)
Yuelong Jin (jinyl0803@163.com)
di qiang (drqiangdi@163.com)
Xiaochun Jiang (drneurosurgery@163.com)
Kang le Zhuang (1169084652@qq.com)

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Reviewer 1

Question 1
In Methods, Data Collection: Who performed the image processing and preparation of the 10 patient models for VR? Were any standardized methods or techniques used in the preparation? Or were the anatomical models created at the "best discretion" of the operator?

Answer
Xuefei Shao is a neurosurgeon who collects clinical information. Quan Yuan is an imaging doctor who collects complete imaging data.

Data were collected from patients that underwent CT scanning (SOMATOM Definition Flash, Siemens) and CT angiography. Methods applied in these scanning approaches included the following: KV: 120 KV; mAs: CARE Dose4D; and slice: 0.75 mm. Algorithms included the following: SAFIRE Kernel: H10f very smooth; Window: CT; Angio w: 700, L: 80, and FOV: 210×210 mm. Contrast agents were injected with use of iodophor at a dosing regimen of 350 mg/ml and 5 ml/s. Magnetic resonance examination (MRI; MAGNETIOM Avanto Dot, Siemens) sequence 1: t1_mpr_sag_p2+c; matrix: 256 x 228; Flip: 150; TR: 1910 MS; TE: 3.07 ms; T1: 1100ms; and ThK: 1mm. BW: 130 Hz/Px; and FOV: 234 x 250 mm. Sequence 2: TOF-3D: Matrix: 256 x 196; Flip: 250; TR: 25 ms; TE: 7 ms; ThK: 0.8 mm; BW: 121 Hz/Px; and FOV: 183 x 230 mm. After scanning, the aggregated data was imported using the 3D-Slicer software program. Threshold, Islands, Draw Tube, Logical operators,
surface cut and other functional modules in the Segment Editor function were used for threshold segmentation. Finally, the generated modeling data were exported to STL formatted files, and the STL files were imported into Microsoft Hololens® glasses using the Unity-3D development software program.

These virtual reality images not only bring students real feelings, but also are very helpful for the surgeon.

Question 2
In Methods, Teaching Methods: Was it a conscious decision not to expose the experimental group to the traditional learning materials at all? And if the intent was to teach specific surgical intervention techniques, why not expose the control group to real case data (but without AR or VR)?
Answer
During the experiment, virtual reality teaching group does not need to contact and learn traditional textbooks. All knowledge points are integrated and imparted in virtual teaching. Surgery is only a means to enhance learning, not a deliberate learning of surgical skills. Before that, we tried to use CBL (Case-based learning, CBL) teaching mode, but the results were not very good.

Question 3.
In Discussion: Many of the advantages of using VR are discussed, but none of the limitations or current weaknesses of VR for teaching surgical anatomy are mentioned. I am concerned that the result is a rather one-sided discussion that does not represent the reality of the present state of affairs. Additionally, it's state that "the excellent interaction provided by virtual technology..." but reviewing the supplementary video would indicate to me that the interaction is anything but "excellent". Overall, I believe this research has merit and represents some contribution to the body of knowledge related to the use of VR/AR technology in surgical education. I would recommend that revisions be made to improve the clarity in the description of the methodology, and a revisiting of the discussion of results, before the manuscript is accepted for publication.
Answer
Very good suggestions. We have been added to the discussion.
“VR technology is the product of the intersection, infiltration and integration of multi-disciplinary fields. There is still a long way to go to make it a widely accepted by medical education, including the development and innovation of software and hardware, and the strengthening of the great relationship with clinical practice.”

Reviewer 2

Question in GENERAL COMMENTS:
Question 1 It is not clear to me who comprised the study group. Are these medical students? Or are they all of different levels of training?
Answer Thirty clinical undergraduates from the class of 2016.

Question 2 Presumptively some might have had endoscopic experience, or prior training in anatomy. Were these factors different between the traditional and virtual groups?
Answer All students from the same grade, they have the same level of education.
Question 3 It would also be interesting to know if each group was aware of the methodologies offer to the other group. It should be more clear in the methodology (under the clinical case information) that the 10 cases of skull base tumors were reconstructed by simulation. It seems that one primary conclusion is that the students felt that the virtual teaching was valuable. Although important, it would seem more impactful if each group of students was blinded to the other arm. Although it appears that the teaching methods addressed knowledge of the anatomy and proximity of critical structures to one another, it is not clear whether this is learning Would extend to surgical anatomy as viewed either directly and/or endoscopically.

Answer surgical anatomy and endoscopically are very good teaching method, we will join in the future research.


Answer Have increased the ”2” as reference “11”.