3-1-2022

Commentary: Posterior Cervical Decompression and Fusion With Exoscope: 2-Dimensional Operative Video

Travis Hamilton
Henry Ford Health, THAMILT8@hfhs.org

Victor Chang
Henry Ford Health, vchang1@hfhs.org

Commentary: Posterior Cervical Decompression and Fusion With Exoscope: 2-Dimensional Operative Video

Travis Hamilton, MD
Victor Chang, MD

Department of Neurosurgery, Henry Ford Hospital, Detroit, Michigan, USA

Correspondence:
Victor Chang, MD,
Department of Neurosurgery,
Henry Ford Hospital,
2799 W Grand Blvd,
Detroit, MI 48202, USA.
Email: vchang1@hfhs.org

Received, October 26, 2021.
Accepted, October 29, 2021.
Published Online, January 14, 2022.

The authors demonstrate the first video operative application of a 4K high-definition 3-dimensional (3D) exoscope for a multilevel posterior cervical decompression and fusion for a patient with multilevel spondylotic myelopathy.[1] The authors highlighted the technical advantages of using the exoscope including a more ergonomic posture for the surgeon and greater visibility for teaching and operating room (OR) staff participation. The challenge of incorporating the exoscope in surgery is the adjustment period required for surgeons to adapt to an indirect operative field and the angulation of the camera to avoid collision, contamination, and obstructed field of view.

Microscopic-assisted surgery has been a standard adaptation to neurosurgical practice since the introduction of the operative microscope (OM) and loupe microscope in 1957 by Theodor Kurze.[2] Telescope-based surgery has continued to evolve in most surgical disciplines over the past 2 to 3 decades although limited focal length and technical feasibility has constrained its applicability in neurosurgery.[3] With the advancement of 3D capabilities and the integration of high-quality video systems, the use of the exoscope has proven more useful in standard neurosurgical procedures. There has been a dramatic increase in publications involving the use of an intraoperative exoscope within the past several years, particularly in spine surgery.[4]

The principal advantage in shifting from loupe and OM to exoscope-assisted surgery is the preservation of an ergonomic posture, which reduces physical strain on the surgeon for long operative periods. However, the teleological drawback of adapting this into practice can include a fear of patient safety and change in OR setup and flow of procedure. When compared with the OM for both cranial and spine cases, surgeons rated the exoscope as noninferior for image quality and superior in comfort level, posture, and instrument handling.[5] Siller et al.[6] evaluated the use of the 4K 3D exoscope in anterior cervical and posterior lumbar cases, demonstrating similar outcomes when compared with a standard OM. A few benefits highlighted were the lack of excess occupied space provided by the exoscope and open visualization and participation of secondary assistants and scrub technicians. In addition, the authors reported no significant differences in operative time, intraoperative blood loss, and length of stay between the 2 intraoperative visualization modalities. Another advantage of the exoscope is that both the surgeon and assistants share the same 3D, "surgeon's eye" view compared with the standard OM, which usually restricts visual depth perception to the lead surgeon's binocular lens and projection to a two-dimensional screen. This can allow for active participation of both surgeons with reduced fear of iatrogenic injury because of lack of proper depth perception in procedural steps that obviate laterality.

A technical issue noted was the shorter operative focal length of some exoscope platforms (VITOM, 3-20 mm), which can introduce the possibility of obstructed view or collision with other operative instruments and surgeons. Other exoscope systems range in focal length between 200 and 650 mm while the OM is typically capable of a focal length between 200 and 400 mm but can be cumbersome and sometimes a challenge to work around.[7] Another consideration is the optical capabilities of the platform when performing high acuity tasks such as the identification of active bleeding, rated as inferior with a non-4K exoscope projected on a smaller display screen compared with a standard OM.[5] Other drawbacks include mixed reports on headaches, dizziness, and nausea associated with the use of polarized 3D glasses,[4,7] which may be associated with specific exoscope models.

Regarding the applicability specifically to posterior cervical cases, there are currently limited studies available that explicitly comment on the feasibility of the exoscope for multilevel posterior cervical decompression with fusions. Oertel et al.[5] classified the experience of the exoscope with both cranial and spinal cases; however, no comments were made explicitly regarding posterior cervical decompressions with fusion. Kwan et al[8] noted the advantage of having OR staff sharing the same view as the surgeon with the drawback of having to reposition intraoperative monitors for posterior cervical decompression alone. A technical challenge specific to this case could include the actual decompression of the cervical lamina with a high-speed drill because it is difficult to assess the degree of laminar breach by the drill without direct visualization at the laminar/lateral mass junction. Typically, this would require direct angulation parallel to the same trajectory as the drill and nearly perpendicular to the laminar/lateral mass junction which would be an obstructive line of view. Although no iatrogenic injuries were noted in the previously mentioned studies, the comparisons made with this specific case are limited. As observed in the video, the surgeons still wore loupes and headlamps, which should theoretically be unnecessary with the exoscope.[9]

As with all new and innovative technologies, the learning curve and implementation into a standard OR setup can be overcome with time and training.[7] Exoscopes provide significant advantages to the surgeon and surrounding operative staff. Overall, the investment made in this tool should also coincide with the options provided by each platform and its overall use including cost, ergonomics, optic capabilities, focal length, illumination of the operative field, and integration with navigation and robotic systems. We congratulate the authors on their contribution to the literature.

Funding

This study did not receive any funding or financial support.

Disclosures

The authors have no personal, financial, or institutional interest in any of the drugs, materials, or devices described in this article. Dr Chang is a consultant for Globus Medical. He receives some research funding (not directly related to this study) from Blue Cross Blue Shield.

REFERENCES

1. Srinivasan ES, Crutcher CL, Shaffrey CI, Gottfried ON, Than KD. Posterior cervical decompression and fusion with exoscope: 2-dimensional operative video. *Oper Neurosurg.* 2022;22(2):83.
2. Uluç K, Kujoth GC, Başkaya MK. Operating microscopes: past, present, and future. *Neurosurg Focus.* 2009;27(3):E4.
3. Mamelak AN, Nobuto T, Berci G. Initial clinical experience with a high-definition exoscope system for microneurosurgery. *Neurosurgery.* 2010;67(2): 476-483.
4. Burkhardt BW, Csokonay A, Oertel JM. 3D-exoscopic visualization using the VITOM-3D in cranial and spinal neurosurgery. What are the limitations? *Clin Neurol Neurosurg.* 2020;198:106101.
5. Oertel JM, Burkhardt BW. Vitom-3D for exoscopic neurosurgery: initial experience in cranial and spinal procedures. *World Neurosurg.* 2017;105: 153-162.
6. Siller S, Zoellner C, Fuetsch M, Trabold R, Tonn JC, Zausinger S. A high-definition 3D exoscope as an alternative to the operating microscope in spinal microsurgery. *J Neurosurg Spine.* 2020;33(5):1-10.
7. Langer DJ, White TG, Schulder M, Boockvar JA, Labib M, Lawton MT. Advances in intraoperative optics: a brief review of current exoscope platforms. *Oper Neurosurg.* 2020;19(1):84-93.
8. Kwan K, Schneider JR, Du V, et al. Lessons learned using a high-definition 3-dimensional exoscope for spinal surgery. *Oper Neurosurg.* 2019;16(5):619-625.
9. Ohiorhenuan IE, Godzik J, Uribe JS. Single-position surgery: prone lateral lumbar interbody fusion: 2-dimensional operative video. *Oper Neurosurg.* 2021;20(5): E369.