

Wearable Video Display Allowing Freedom in Head Positioning for Brain Mapping

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Awake brain mapping is the gold standard for localization of dominant-hemisphere cortical language functions and in the appropriately selected patient, it may allow the surgeon to avoid eloquent cortex and/or perform a more aggressive surgery of lesions situated in adjacent non-eloquent cortex¹⁻³. For intra-operative object naming, the patient is most commonly placed in the lateral position providing them an unobstructed view of a screen with the object to be named⁴. This is largely due to the fact that the majority of cases in which language mapping is performed are in the temporal or inferior frontal lobe. However if the choice of positioning is not lateral, yet language mapping would be preferable, some positions may make it difficult or impossible to view objects on a screen. At Toronto Western Hospital in Toronto, Canada, we have found utility in the use of a wearable video display when mapping cortical language function, either routinely in temporal and frontal regions, or in positions not typically employed in standard temporal cases. In this article, we describe the basic setup of this device, focus on the key procedural steps required to replicate this setup, describe our experience with this technique and highlight some of the important anesthetic considerations.

Setup of the wearable video display device

The MicroOptical Myvu glasses© (Myvu Corporation, Westwood, Massachusetts) display is attached to a set of safety glasses that have been modified, by removing the contralateral temple to avoid interference with the incision [Figure 1]. However, the ipsilateral (to the incision) portion of the frame and lens are preserved. The preserved non-viewing eye lens is occluded by placing opaque tape over the plastic lens of the safety glasses. This greatly facilitates monocular viewing. The video output of the laptop computer is sent to the miniature display via a standard video connection. Black and white high contrast pictures of objects to be named are placed on individual slides in a PowerPoint presentation and displayed serially at the time of stimulation mapping. A sound is played at the onset and offset of each picture. The computer output display is configured so that objects displayed on the laptop are simultaneously displayed on this device, and the screen of the laptop is placed such that the surgeon can visualize the slides. The auditory and visual feedback for the surgeon facilitates the timing of the delivery of cortical stimulation, and the visualization helps the surgeon ascertain the accuracy of naming.

MicroOptical Myvu glasses© (Myvu Corporation, Westwood, Massachusetts) has a 640 by 480 video graphics array liquid-crystal-display with 24-bit colour depth and a ratio of 4:3. Other benefits of this device are that it is light-weight and



Figure 1: Preoperative photograph demonstrating patient positioning and application of video display. The patient had a mesial frontal lesion, and both motor and language mapping were to be performed in the dominant supplementary motor area. This would not have been easily achieved with alternate methods. Final taping and occlusion have not been completed at this time.

has 'clip-on' lens technology that makes attaching and removing it from the safety glasses very easy.

Key procedural steps

- 1) After antibiotic and anticonvulsant medication administration preoperatively, the patient is placed in the desired position. For temporal lobe surgery, all patients are uniformly in the

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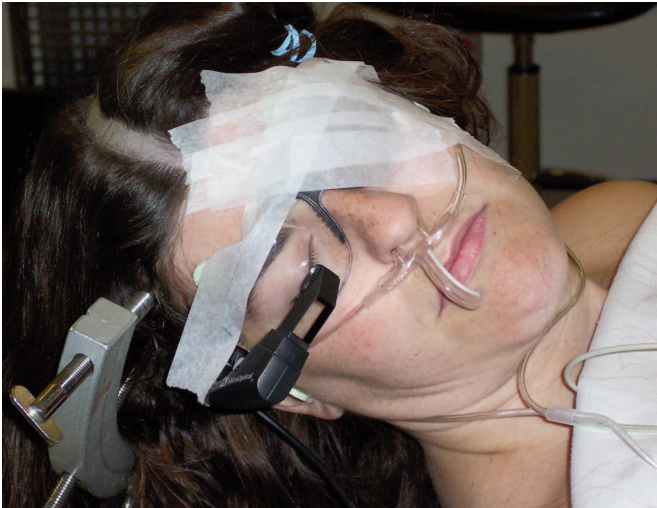


Figure 2: Preoperative photograph demonstrating securing of the safety glasses to the face with tape and also achieving monocular viewing. In addition, the Sugita head rest device is placed away from the safety glasses to ensure its freedom for intraoperative adjustments if necessary. The tape near the incision was trimmed prior to application of sterile preparation and draping.

supine position, with the head turned approximately 30 degrees off midline, away from the operative site. However, this device has been utilized in a patient with a parietal lobule meningioangiomas where language mapping was utilized as we encroached on the supramarginal gyrus in the dominant hemisphere. In this case the patient was in the park bench position with the head turned down towards the floor.

- 2) Great efforts are made to ensure patient comfort for the entirety of the procedure⁵. Notably the routine use of the supine position for awake temporal lobe surgery considerably facilitates language mapping.
- 3) Sedative medications are administered (Propofol and Remifentanyl at our institution) and the patient is then placed in a rigid head fixation device (Sugita head rest at our institution) with local anesthetic (Bupivacaine) injected at the pin sites. For temporal lobe surgery it is very important to place the frontal pin of the Sugita headrest well way from the orbit, and thus above the superior temporal line to ensure the Sugita ring clamp (that is placed during surgery) has adequate clearance from the safety glasses [Figure 2]. If this is not done it can be difficult to place the display back on the bracket of the safety-glasses at the time of mapping.
- 4) Once the sedation is relieved and the patient is fully awake and compliant, the safety glasses (with the bracket of the display attached) are placed and taped into place. Note that there is only one handle on the safety glasses and this taping must be done securely to avoid movement during the surgery. The safety glasses remain on for the duration of the surgery. The wearable video display is then attached to the bracket on the safety glasses, and adjusted for optimal viewing. The display can be focused to accommodate for myopia. At this stage, we ask the patient to view images (transmitted to the device via a laptop computer) on the miniature display, and

adjustments are made to the positioning of the safety glasses and focus of the display device. The highest myope tested to date required glasses with a refractive index of 4.25. Despite this, visualization was adequate without correction.

- 5) Once optimal positioning has been achieved, the glasses are taped to the patient to secure its position; in addition, we tape over the ipsilateral eye to facilitate monocular viewing [Figure 2].
- 6) The laptop computer delivering the stimuli is placed in a comfortable position for viewing by the surgeon and the device is connected to the laptop computer via a standard video out [Figure 3]. This obviates the requirement of another individual ascertaining the accuracy of the answers, and facilitates the timing of cortical stimulation to the presentation of the visual stimulus.
- 7) A microphone is placed in front of the patient's mouth to facilitate communication with the surgeon and operating room staff.
- 8) Sterile draping is applied ensuring that the anaesthesiologist has access to the patient's face.

Option: For patient comfort, the display can be removed and reattached to the safety glasses immediately prior to stimulation-mapping.

Clinical pearls

- 1) A selection of several goggle sizes will facilitate patient comfort especially at extreme head sizes.
- 2) The procedure is discussed with the patient prior to surgery, and the display is tested in those patients who are myopic prior to entering the operating room.
- 3) Care must be taken to ensure adequate placement of the pins of the headrest to avoid obstructing later placement of the display once the Sugita ring is attached.

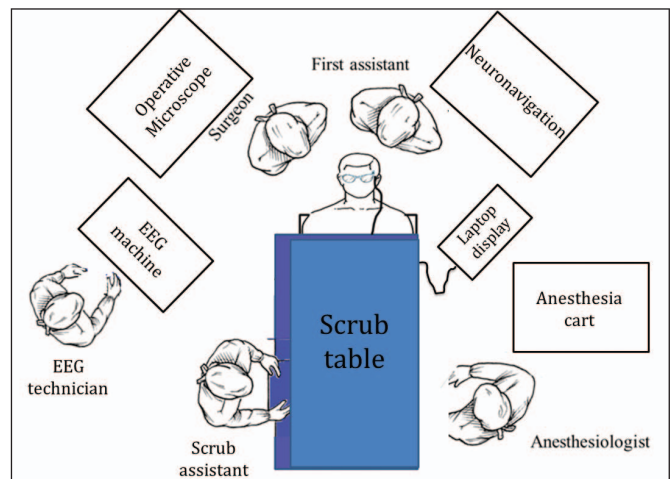


Figure 3: Operating room setup for a right sided craniotomy in the neutral supine position. Note the location of the laptop to allow simultaneous display of the objects for the surgeon.

- 4) Patient visualization of the video display by adjusting the position and focus prior to draping is important to ensure the mapping begins promptly.

Toronto Western Hospital experience

This technique has been successfully utilized in intraoperative language mapping in 38 (19 female) patients undergoing epilepsy surgery between September 2003 and March 2011. The mean patient age was 33 years (range 18 to 55 years). There were no cases where this technique had to be abandoned either due to technical difficulties or patient compliance. In two cases this system was utilized with the patient in the park-bench position and the head turned downwards, for resections within the occipito-temporal and temporal-parietal junctions. Since this technique was adopted early in the senior author's career, our experience with other display systems for language mapping is limited and thus a meaningful comparison is not possible at our institution.

Anesthetic consideration

Important anesthetic considerations for patients undergoing awake craniotomies include patient comfort and airway access. Both of these parameters can be optimized using this device as maintaining a direct line of site for the objects to be named is less of a concern.

DISCUSSION

We have presented a simple addition to awake language mapping that may result in increased patient comfort as well greater freedom in head positioning. There are two main advantages of this technique: 1) This device allows the surgeon more freedom in choosing head position and patient positioning without the added concern for the patient's ability to visualize a monitor used for object naming. This is particularly beneficial in anteriorly or medially situated frontal lobe lesions where neutral positioning may be superior to lateral positioning. In rare instances, this arrangement also permits rotation of the operating table, without concern to visualization of stimuli that might occur with the typically employed lateral position, and screen display of stimuli; 2) This device may be beneficial for patients who are high myopes as objects placed closer to the eye can be focused more easily onto the retina. There are two main disadvantages to this technique: 1) There is a cost of about \$300 United States dollars associated with the purchase of this device; 2) The use of this device may increase operating room time initially but may be minimal with increased experience. Overall this technique may provide a useful addition to the armamentarium of the neurosurgeon that frequently performs intraoperative language mapping.

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