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Short Communication

The Jefferson Operative Room Setup for Endoscopic Skull Base Surgery

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Abstract

Introduction: As dedicated endoscopy suites for skull base surgery are becoming more prevalent, it is important to consider the optimal operative room setup. Multiple techniques have been presented for surgeon positioning for two-team endoscopic skull base surgery. Classically, the neurosurgeon and otolaryngologist stand adjacent to each other on the same side of the patient bed while operating. We describe an alternative approach utilizing dynamic endoscopy where the two surgeons stand across from each other. We discuss the merits of this approach from both a neurosurgical and otolaryngological perspective.

Methods and results: We describe our technique of surgeon positioning, monitor positioning, operating room setup, and their implications on ergonomics and surgeon fatigability.

Conclusion: We believe our approach of surgeon positioning, where surgeons stand on opposite sides of the patient bed while operating, to be a viable and more ergonomic alternative to the classical approach.

ABBREVIATIONS

FESS: Functional Endoscopic Sinus Surgery; EES: Endoscopic Endonasal Surgery

INTRODUCTION

In contrast to functional endoscopic sinus surgery (FESS), which requires just one surgeon and 2 hands while operating, endoscopic skull base surgery requires 2 surgeons and 4 hands. This has created a unique problem in finding a way to adequately position both surgeons so as to maximize exposure and lend to an ergonomically practical method for long cases. To address these concerns, several authors have popularized various operative techniques as being the mainstay for skull base surgeons.

Snyderman *et al.* [1] and Louis *et al.* [2] describe a single-sided technique whereby both surgeons are positioned to the right of the supine patient; the scrub nurse is also positioned to the right of the patient but further towards the foot of the bed (Figure 1). This setup allows the nurse and surgeon to efficiently transfer instruments without the surgeon turning from the monitor. It also allows for both surgeons to have a comfortable operative position on the patient's right. Additionally, two video monitors displaying the endoscopic picture are positioned orthogonally to one another, with the possibility for a third monitor for neuronavigation placed in between.

MATERIALS AND METHODS (TECHNIQUE)

Herein we outline our operative set up for surgeon positioning during endoscopic skull base surgery. In contrast to the previously reported techniques, we routinely perform these cases with the surgeons standing on opposite sides of the patient. In our model, the neurosurgeon stands on the right side of the patient and the otolaryngologist on the left side of the patient. The ENT, however, starts the approach on the patient's right. Once the approach is complete (sphenoid and sella opened), then the intracranial dissection turns into a two-surgeon approach and the ENT goes to the patient's left while the neurosurgeon goes to the patients right. The endoscope is placed in the left nostril during the neurosurgical portion of the surgery. After the resection and reconstruction are complete, the ENT goes back to the patient's right and completes any remaining closure or medialization of the middle turbinates. This allows for both surgeons to work simultaneously -- the otolaryngologist performing dynamic endoscopy while the neurosurgeon performs intracranial work.

The scrub nurse is positioned further down the bed on the same side as the surgeon dedicated to dynamic endoscopy;

anesthesia is positioned at the foot of the bed. Ceiling mounted monitor displays are positioned approximately 1 meter directly in front of each surgeon. Additionally, this set up easily allows for simultaneous fascia lata graft harvest without interfering with the surgeons at the head of the patient. Depending on the available space in the operating room, the fascia harvest always takes place on the side opposite the scrub tech. This setup is depicted in (Figure 2).

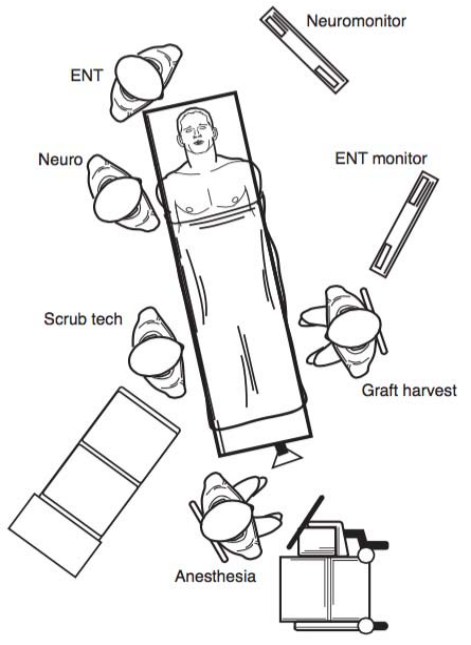

Figure 1 Classical operative room setup for endoscopic skullbase surgery with both surgeons positioned to the right of the patient.

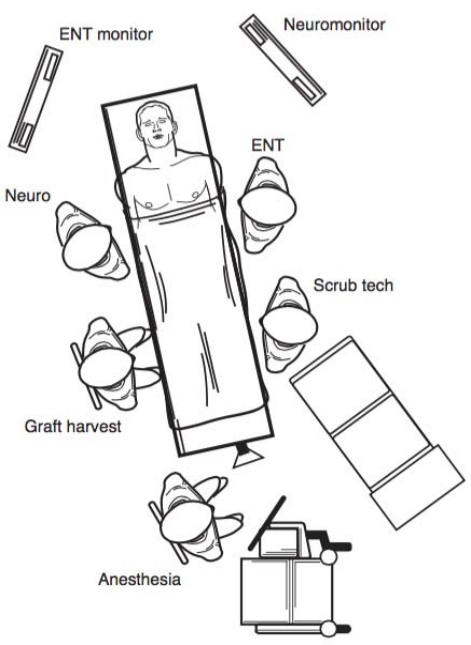

Figure 2 Jefferson operative room setup for endoscopic skull base surgery with each surgeon standing on opposite sides of the patient.

RESULTS AND DISCUSSION

Developments in technology have been instrumental in advancing surgical capabilities in sinus and skull base surgery. This includes the use of stereotactic navigation and high definition video technology. In order to avoid cluttering of valuable space around the patient for multiple surgeons, protect these valuable pieces of equipment from damage, and maximize ergonomic positioning, many institutions have invested in dedicated sinus and skullbase endoscopy suites. Designing dedicated sinus and skullbase surgical suites requires careful planning for placement of ceiling mounted image guidance and video screens. Thus, sinus and skullbase centers should carefully consider surgeon positioning before making this investment. Our technique has become the mainstay for skull base surgeries at our institution and we have adopted this setup for about 10 years, carrying out over 1500 skullbase surgeries since that time.

There are several advantages to using this method of surgeon positioning. Because we are standing on both sides and not forcing both surgeons on one side, there is more space to move hands and instruments outside of the nose. The neurosurgeon works primarily through the right nostril but has the option of using his/her right hand in the left nostril as well, allowing for a bi-narial approach; the endoscopist works through the left nostril. By decreasing crowding during endonasal instrumentation, our method avoids awkward positioning that would otherwise increase surgeon fatigue and muscular strain. Both surgeons can work in the same direction and neither surgeon is working upside-down. This orientation facilitates a true four-handed technique as the neurosurgeon can work uni- or bi-narial, and the ENT can hold the scope in the left nostril while using an instrument in the left side.

This setup also allows use of mask-based neuronavigation when a clear line of sight is required between the infrared camera and surgical hand piece. Crowding is avoided and a third surgeon can easily harvest a fascia lata graft without interfering with the operation or visualization of monitors (Figure 2). This juxtaposes the classical setup, which creates a line of sight issue with the harvest graft's proximity to the ENT monitor (Figure 1). Additionally, this setup can also facilitate a left-handed surgeon by simply having the two surgeons swap sides. If a scope holder is used in place of dynamic endoscopy, the holder would be placed on the side opposite the operating surgeon. The use of a scope holder would be very difficult to place in the alternatively described practice.

For all endoscopic sinus cases, our practice has routinely positioned anesthesia at the foot of the bed and the Otolaryngologist closest to the patient's head. This allows immediate airway management by the Otolaryngologist in an acute airway emergency. No reported cases of loss of an airway have been reported due to having anesthesia at the foot of the bed, and a preoperative discussion with anesthesia allows for coordination and delegation of responsibilities in the event of a true airway emergency.

A potential disadvantage of our technique is that the assistant has to hold the camera with the left hand, which may be awkward as it is the non-dominant hand for most people. However, this

does not appear to be a noticeable drawback in clinical practice. Furthermore, in our institution, both the neurosurgeon and ENT are capable of controlling bleeding without the need for both surgeons to be on the same side of the patient to rapidly allow ENT to take over control. Occasionally, it may be necessary for the ENT to return to the other side, but this is rare. It is also unusual for the ENT to have to return to take more septum or gain more exposure after the neurosurgeon has begun working. If more exposure is needed, the neurosurgeon can usually accomplish this without the need for the ENT to return to the patient's right.

There are few studies examining the ergonomics of the overall operative room setup, and scientific data addressing surgeon positioning are even more scarce. Laparoscopic instruments in particular suffer from ergonomically inadequate handle designs and inefficient handle to tip force transmission [3]. Little *et al.* found that 48/62 (77%) surgeons had experienced physical discomfort or symptoms that they attributed to performing endoscopic endonasal surgery (EES), with 73% claiming that the ergonomics of endoscopic surgery impact surgeon fatigue [4, 5]. Furthermore, 74% of surgeons found endoscopic skullbase surgery to be more ergonomically taxing than functional EES. Upon assessing the ergonomics of the operating room (OR), Berguer states that the traditional OR layout has been created by placing staff and equipment into a predefined space. Instead of forcing the endoscope into the traditional OR setup, he proposes creating a novel layout that is built around the endoscope itself [3,6,7].

Our method of surgeon positioning has several ergonomic advantages. It allows for optimal monitor positioning for each surgeon, which according to a study by Kelts *et al.* is approximately 1 meter away and directly in front of (180°) each surgeon with a flexible monitor height of 0-15 degrees below the eye level of each surgeon [8]. Beyond this height range, Bauer and Wittig found that there was increased cervical muscle activity among surgeons [9]. Additionally, van Det et al. found the optimal position to be no more than 15 degrees to the left or right of the surgeon in the horizontal plane [10]. A randomized controlled trial by Haveran *et al.* found the worst performance was observed when the monitor was located to the right of midline (240°), with a significantly prolonged time to task completion compared to the 180° position for both experienced (7.9 *vs.* 7.2 sec, p = 0.04) and novice (11.4 *vs.* 9.9 sec, p = 0.03) surgeons [11]. With surgeons on opposite sides looking straight ahead at their respective monitors, our setup prevents surgeons from having to turn their necks and decreases cervical muscle strain. Although our setup depicts ceiling-mounted monitors, it can also be applied to cart monitor systems as well. Further, this setup accommodates for issues related to the physical attributes of the surgeons, such as body mass index and height, which are mitigated by having surgeons separated on opposite sides of the bed.

One study by Vaz-Guimaraes *et al*. sought to compare different endoscope positioning and microsurgical dissection techniques in EES training to determine an optimal standard technique that can be used in teaching EES [12]. In this series, 12 trainees without any or very limited experience were randomly assigned to one of three groups: A) one single surgeon performing binarial two-handed dissection using an endoscope holder (rigid endoscopy); B) two surgeons performing a combined binarial two- and three-handed dissection with one surgeon guiding the endoscope (dynamic endoscopy); C) two surgeons performing a binarial two-handed dissection with one surgeon fully dedicated to endoscope positioning and the other one fully dedicated to a two-handed dissection. A distinction was not made whether both surgeons operated on the same or opposite sides of the bed. Using a global rating scale and specific task checklist, they determined that group C had a significantly positive impact of dynamic endoscopy and bimanual dissection on training performance. Although they did not directly compare the advantage of having both surgeons stand on opposite sides versus the same side, this is one of few studies in the literature with scientific data related to an operative room setup for EES.

As dedicated endoscopy suites for skull base surgery are becoming more prevalent, it is important to consider the optimal operative room setup. This emphasizes the utility of exploring alternative operative room setups, including ours at Jefferson. Those who have trained at Jefferson have taken this technique to their institutions and it is starting to garner more interest internationally. Overall, our setup maximizes surgeon dexterity and maneuverability, offering several ergonomic advantages compared to the classical operative room setup. Further studies with quantifiable outcome measures are needed to confirm the benefit of our operative room setup over others from both an ergonomic and patient care standpoint.

CONCLUSION

We present an alternative approach of surgeon positioning for two-team endoscopic skull base surgery, where surgeons stand on opposite sides of the patient bed while operating. We believe this to be a viable and more ergonomic alternative to the classical approach of both surgeons operating on the same side of the bed.

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