Intraoperative Functional Endoscopic Sinus Surgery Training: Efficient Teaching Techniques—A New Method

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ABSTRACT

INTRODUCTION: Functional endoscopic sinus surgery is a complex procedure used by otorhinolaryngologists to treat a host of nasal sinus pathologies. Due to the involved nasal anatomy and the nature of the procedure, teaching residents to use an endoscope is challenging. Simulation labs have been helpful but intraoperative instruction can still present difficulty in communication between resident and attending physicians during the teaching process. The purpose of this is to hypothesize a method of teaching intraoperatively that can be used supplemental to or independently of virtual reality teaching.

METHOD: Literature review to determine current intraoperative verbal teaching methods used by surgeons was performed. Review was also performed on the effects of simulation techniques in preparing residents for the operating room. Although this was not a systematic review including statistical analysis, a gap was found in the literature on how residents can be efficiently taught intraoperatively to navigate an endoscope while maintaining patient safety. A novel and inexpensive method has been devised as a possible teaching method.

CONCLUSIONS: Extensive literature is not available in intraoperative teaching techniques. It is therefore uncertain whether such a method has been used before. Further study, possibly in the form of surveys and intraoperative trials, must be done to determine the effectiveness of this mechanism.

KEYWORDS: FESS, resident education, surgical education, endoscopic training

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Introduction

Functional endoscopic sinus surgery (FESS) is a complex procedure used by otorhinolarynologists to treat chronic sinusitis, nasal polyps, pituitary tumors, and a host of other nasal sinus pathologies. Due to the sinuses' location near the cranium and orbit as well as its propensity for bleeding, this is a delicate procedure that requires skill and precision.[1] The use of an endoscope is not always intuitive and the nasal cavity can be challenging to navigate. This has pushed the residents' training in the FESS procedure toward virtual reality (VR).[2,3,4,5] However, little research has been done on intraoperative training of residents in this procedure and how attending physicians can efficiently communicate with their students during the procedure while maintaining patient safety. Some research has been done on endoscopic training regarding the gastrointestinal system[6] and extrapolations were made.

The purpose of this article is to look at the use of simulation, explore current intraoperative teaching methods, and propose a new method of communication between the experienced physician and the learning resident. New communication techniques are anticipated to help the resident, particularly in early training, navigate the nasal cavity safely.

Method

A literature review was performed on the usage of VR and current general intraoperative teaching methods. Studies were analyzed for use of VR, feedback from students trained with VR, and positive outcomes. Of these, any research that did not have endoscopic use, that could be extrapolated, or were not directly related to endoscopic sinus surgery was omitted. Verbal teaching methods were reviewed, as well,[6] to identify standard approaches toward teaching residents on the field. Using this as a foundation, a hypothetical model for intraoperative teaching of FESS was created. A positive correlation between VR training and performance of FESS was established by numerous studies.[2,7] Although students demonstrated greater dexterity and fewer mistakes after practicing with simulation-based training,[8] once in the operating room (OR), attending physicians still sustained the challenge of instructing students through traversing the nasal cavity. Due to the nature of endoscopy, much of the teaching that occurs in the OR during an FESS is verbal particularly because of the impracticality for a physician to assist with an endoscope.[6] Ideally, this instruction should be simple to follow, maintain accuracy, and minimize OR time without compromising patient safety. Therefore, a new method of intraoperative verbal teaching was proposed to enhance communication and patient safety during an FESS procedure.

Results

A novel method of communication was proposed to clarify instruction, particularly for beginners in FESS. It used recognition for teaching using verbal technique that is both universally

acceptable and simple to master. This proposal to employ the standard analog clock incorporates simplicity and clarity without expense. As for effectiveness of the technique, the analog clock method was used for residents. For residents beginning to learn the FESS procedure, instruction began as is most commonly done, verbally, with no assistance of the clock. Part way through the procedure, a depiction of a clock was attached to the side of the endoscopic screen and the resident directed in that manner. The resident feedback depicted the clock as simpler to understand than typical up, down, left, and right since there was a rotatory component to the instruction.

While this technique has been used in one program, the method was not made widespread and surveys or other research of its use by other attending physicians have yet to be performed. However, this article was written with the preemptive knowledge of the possible benefits of such a teaching technique intraoperatively.

Discussion

Endoscopic sinus surgery is an extremely challenging surgery confounded by its location and proximity to the brain combined with a 2-dimensional view in a 3-dimensional space. In addition, it comprises numerous critical structures to be navigated within its narrow space.[1] The anatomy of the nasal sinuses makes it important for practitioners to keep in mind important landmarks to avoid complications. As with every procedure, there are some possible minor complications, in this case, tooth pain and nasal ostia closure along with risk of infection. The major complications are more devastating and can include hemorrhage, cerebrospinal fluid leak, damage of extraocular muscles, and blindness due to optic nerve compression.[9,10] Cells of Onodi in the posterior ethmoid sinus may hold the optic nerve and care must be taken when opening the sphenoid ostium.[11] On entry to the sphenoid sinus, maintaining an inferior and medial approach may decrease possible damage to the internal carotid artery.[9] In a review of the literature, numerous studies were found on the effectiveness of simulators and VR training of endoscopy. Despite most of these studies being done regarding gastroenterology, extrapolation can be made for sinus surgery as well. The effectiveness and appropriateness of these simulators regarding clinical practice is discussed at length.[2,7] Most of these studies are based on subjective responses from residents using the simulators with some objective input from the simulation models themselves. However, as noted by Lateef in 2010, these simulators do not fully mimic reality and can be quite expensive to procure. And, although low-cost simulators do exist,[12] their effectiveness relies heavily on quantity of usage and does not account for factors such as teamwork and environment.[13] Taking into account all the downfalls of VR training, there does appear to be some benefit. Users of simulators have been shown to have shorter OR time and increased ability to manipulate surgical tools.[7] This has been corroborated via studies of endoscopic sinus and gastroenterology surgery simulators.[2,5,7,14,15]

Simulation training is designed specifically to increase surgical skill when the opportunity to learn through real patients has diminished. It is necessary to keep in mind, however, that the end result of simulation is the ability to transfer these skills into the operating room. Here, residents can train on actual patients using their basic skills to then increase focus on more complex issues. The effectiveness of VR screens as well as intraoperative performance depends largely on coaching and feedback from attending physicians.[16] In an article from the *Journal of the American College of Surgeons*, briefing residents before a procedure about surgical strategy, teaching in the operating room, positive debriefing of techniques, and indications where improvements could be made are noted as important factors in the learning process.[17]

Most efforts to assess technical skill have focused on assessing performance outside of the operating room.[16] Therefore, the question still arises: When in the operating room how can the supervising surgeon efficiently and effectively communicate to the students, particularly during an FESS where the attending physician must take a less "hands-on" approach?

A study was performed in Canada to assess the types of verbal methods used in teaching endoscopy.[5] Six total verbal teaching methods were identified and of these, motor instruction appeared to be of particular importance during endoscopic sinus surgery education. Motor instruction includes verbally directing residents' movements and telling them where and how to move their instruments.[6] Motor instruction sounds simple but when looked at more closely, it can be challenging for both the student and the attending physician. Students can easily misinterpret directive and either over or undercompensate their movements based on their subjective understanding of the words used. Physicians may find it difficult to use the appropriate terminology geared toward the students' understanding. In addition, the teaching physician must speak accurately, lest the student act before the physician can correct himself. This is especially important, as verbal instruction has also been noted to reflect team performance and individual skill. Poor communication has been identified as a cause of potential operative error.[18]

The difficulty in communication in the operating room is not lost. There are no standard communication techniques and each surgery requires a specific set of skills that make standardization more challenging.[18] Cultural backgrounds and teaching methods differ for each institution perhaps complicating the issue of intraoperative verbal communication even more. Therefore, it is even more imperative to increase verbal precision while teaching to enhance the intraoperative learning experience for learning residents and provide increased benefit to the patient. Primarily, the goal is to increase performance without compromise to patient safety. Creating a technique that is universal in its adaptability will be even more beneficial for students as they transition into full-fledged attending physicians.

In one study done by Hauge et al, 4 categories of intraoperative teaching behaviors were measured. These categories included informing the resident of what to do, questioning on the next

appropriate step, responding to what was already done, and setting the tone for the work environment.[19] Each of these proved important to the learning environment in the operating room with a time and place for each category. In fact, each of these categories can be viewed as subdivisions of a verbal technique. The study monitored these categories using videotaped operations. This may have skewed results as physician instructors may have a propensity to behave differently when under the watchful eye of a video camera. Nonetheless, each of these categories is still valuable to include in the operative teaching environment.[19]

In answer to this question of the most efficient communication method while teaching an FESS, a new method of teaching was proposed, particularly for beginners in FESS. This method was proposed based on the need for common ground on which to base the movements of the students. The thought process was to create a universally acceptable method of communication in the operating room. Therefore, a universally familiar device was suggested: the standard analog clock. With its round shape it is easily placed alongside the endoscopic screen where students can refer to it at any time. It may be even easier for students to refer the numbers on the clock if they were placed directly over the endoscopic screen using a plastic transparent sheet. This would remove the need for residents to look away from their camera screen. With the clock aligned with the endoscopic photo, it can become nearly effortless for the attending surgeon to direct his students. This addressed the challenge chiefly pertinent but not limited to beginners who may struggle to register direction such as superior vs inferior, medial vs lateral, and nasally or septally while viewing a screen. It is expected for students to have an easier time understanding movements in reference to the numbers on the clock rather than abstract words such as "toward the left" which can be misinterpreted as the residents' left or the patients' left. For example, simply saying "lean your microdebrider on the number 9 position with its opening facing the number 3 position" can be more clearly understood than "put your microdebrider medial and face it lateral" or "place your microdebrider on the septum to debride the middle turbinate." Again, this may be true more so for the resident with little intranasal endoscopic experience and may still be challenged in manipulating instruments and managing the complicated anatomy while working via a screen.

In addition, the numbers on the clock are located at the same place every time providing consistency. When an attending physician directs a student to adjust a tool, rather than using words such as "slightly" or "a little" which can mean different things to different people, the surgeon can use the numbers on the clock. An example would be "readjust to place your freer halfway between numbers two and three." In this way, the surgeon is sure that the resident will learn exactly how to adjust correctly. Finally, the numbers on the clock are universal in their location and do not change. This makes the clock method adaptable with any surgeon at any institution in any country. When this method is scrutinized more thoroughly, it is evident that it can easily incorporate the 4 categories of the study done by Hauge: informing, questioning, responding, and tone setting.[19] The physician can preempt the students' next move, question the student on what he believes should be done next and respond appropriately, all within reasonable time and increased mutual understanding. Because communication is acceptable and hypothesized to be easily understood between the 2 parties using the clock method, the setting in the operating room is expected to be calmer. The supervising doctor, who can take over at any time should an unexpected scenario arise, is proposed to have more confidence in the residents' abilities.

Conclusions

There may be possible fallbacks to this method. One important detriment to consider is the allowance of the student to become comfortable with the numbers and pay less attention to the anatomy. Noting that extensive literature is not available on intraoperative teaching techniques, it is unknown if the abovementioned technique has been used previously. Further study including surveys, increased anecdotal evidence, as well as controlled statistical evidence into the actual effectiveness of each of these techniques would be necessary to fully assess them.

Author Contributions

PGC - Study design, manuscript preparation; HS - Research, manuscript preparation.

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