Overcoming Complications Through Pre-patient Surgical Training in Otolaryngology

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Abstract Planning a balanced academic and practical surgical curriculum that is parallel to the constant innovations in surgical fields is the cornerstone of surgical education. Current training methods have coinciding benefits and drawbacks. In this study, we compare the efficacy of two learning models: pre-patient training outside the operating room versus step-by-step training on real patients in the operating room. Facial nerve preservation in superficial parotidectomy is the surgical model used in the study. Five otolaryngology residents in the third year of their residency participated in this study. They were divided into two groups: a treatment group which underwent a pre-patient training program by cadaver dissection and a control group which followed a step-by-step training model. At the end of the study, significant differences were apparent between two groups in the ability to find facial nerve trunk, microdissection of facial nerve branches, and the mean duration of total operating time. Pre-patient training programs outside the operating room provide surgical

residents the opportunity to learn by trial and error without fear of complications.

Keywords Pre-patient training · Surgical curriculum · Cadaver dissection · Facial nerve paralysis

Introduction

From the stand point of aesthetics results, facial nerve paralysis is the worst complication of parotid gland surgery, both for the patient and surgeon. The effect of facial nerve paralysis on oral competence and lids closure generally has unacceptable morbid results for patients.

Facial nerve paralysis is a well-known example of medical complications which may involve surgeons in legal issues. To prevent such complications, it is essential that the surgeon be extremely skilled in different surgical techniques and knowledgeable about anatomic landmarks. The practical training of a surgeon calls for different methods, some of which take place outside the operating room [1, 2]. Currently accepted surgical training models outside the operating room are virtual reality, live animals, and human cadavers.

This study was performed in two parts. First, we mapped out the anatomic variations of facial nerves in 50 Iranian cadavers as a pre-patient training program. Second, we evaluated how this program can affect the residents' performance during parotid surgery on real patients.

Materials and Methods

The two participants who enrolled in this study were in the third year of an otolaryngology residency program. These

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two were considered as the treatment group, in comparison with the control group comprised of three other residents at the same level of training. The two groups first read parotidectomy and facial nerve dissection guidelines and observed facial nerve microdissections on patients with parotid gland tumors, which were performed by a fellow of head and neck surgery.

In the next step, the treatment group operated on cadavers under the supervision of the same surgeon and explored the facial nerve branches on both sides of 50 cadavers. The facial nerve was explored by the classic approach on one side and the retrograde approach on the other side. After cadaver dissection, the treatment group began operating on real patients under the supervision of trainers. They performed all steps of the surgery as long as patient safety was not compromised.

The control group participated in parotid surgery as the first aid in the operating room. Each parotidectomy was divided into four steps: skin incision and raising flaps; finding the nerve trunk; microdissection of branches and tumor removal; hemostasis and closing the incision. The control group began with the first step and, once having acquired enough experience and speed, continued on to the next steps. When members of the control group could perform all the steps satisfactorily, they were allowed to perform the operation under the supervision of the trainers.

Needless to say, both groups were unaware of being observed for the purposes of the study in order to avoid creating unnecessary stress during the procedures.

At the end of the study, the two groups were compared in the following areas: their ability to find the facial nerve trunk and to perform microdissection of its branches, the time taken to find the trunk, and the overall time of performing surgery.

Results

The study was done during the last one and half years of the participants' residency period. Only the uncomplicated superficial parotidectomy procedures data was analyzed. The treatment group could find the facial nerve trunk by themselves in 90% of uncomplicated superficial parotidectomy procedures. The mean length of time from the skin incision until finding the nerve trunk was about 40 min. The mean duration of total procedures was 2/2 h in an uncomplicated superficial parotidectomy. Unexpected facial nerve paralysis did not occur in this group.

The control group could find the facial nerve trunk unassisted in about 30% of uncomplicated superficial parotidectomy procedures and could perform the four steps of surgery in 20% of all procedures. The mean length of time from the skin incision until finding the nerve trunk

was about 70 min. The mean duration of all procedures performed by the control group was 3/5 h with matched patients. Due to close supervision by trainers, unexpected facial nerve paralysis did not occur. We analyzed the time results of the two groups with the non-parametric Mann–Whitney test Fig. 1. There was a significant difference between the mean surgical duration of the two groups in this test ($p = 0.013$). Again, a t test analysis reported a significant difference between the two groups ($p = 0.003$). Because the participants were small in number, they had the opportunity to perform superficial parotidectomy numerous times. For this reason, the non-parametric Mann–Whitney test result for these small groups shows a significant difference ($p = 0.003$).

Discussion

As surgical procedures become highly complex, there is no doubt that training residents to be skilful surgeons is the main objective of surgical curricula. In the short span of a residency, the mastering of all procedures may not be possible. However, today's surgeons are expected to be infallible under the law. Facial nerve paralysis during parotid gland surgery is a perfect example of medical error sequels, as this complication is immediately apparent after surgery, even to lay people.

Surgical curricula must have correct education ratios for all trainees of different levels and scheduling such programs is very challenging due to its time limitations. Moreover, some universities limit duty hours to prevent medical errors caused by resident fatigue [3, 4]. However, despite its good intentions, such a measure compromises the quality and quantity of training received. For this reason, other educational methods are necessary to raise the trainee's learning curve.

It must be noted, on the other hand, that each individual has a different learning curve and so not all residents acquire skills as quickly as the others. To address this, a

Fig. 1 Time results of two groups

proficiency-based training program would allow residents to graduate once they have successfully completed the curriculum without any regard to time [2]. Again, this has its own problems. Most residents are in their thirties which may have negative effect on the learning curve.

In conclusion, an ideal surgical curriculum must provide a balance between educational training and overall work time [2].

In order to decrease the time wasted by junior doctors, especially in overcrowded and busy centers, a stepwise approach in teaching is advised [5]. This stepwise program can be performed in two manners.

First, the surgical trainees can learn any approach step by step on real patients as a part of their daily schedule, which can be a time-consuming process in busy centers. In this way, the trainees pass through a multistep program. Usually, this starts with verbal instructions about the procedure followed by observing the actual procedure performed by an expert surgeon several times. At the practical level, trainees would participate in operations under close supervision. In the final stage, the trainees work as the primary surgeon [6].

The two important points in a motor learning model such as this are the number of demonstrations and the observance of an expert model. Multiple exposures produce more accurate knowledge, but it strongly depends on task difficulty and the intelligence of the trainees. Adams and Schmidt's theories indicate that observing less expert models results in trainees learning from errors and propose that the cornerstone of motor learning is actual practice. On the other hand, Sheffield believed that observing an expert model can build up a "perceptual blue print" in the memory of observers and so produce adequate knowledge to perform a task. However, little information is gathered about possible errors [6]. If the goal of education is to learn a new task without having any previous information, then verbal descriptions, modeling and multiple physical practices are necessary to produce an appropriate movement pattern, even though the relative effect of these three upon each other has been unclear. On the other hand, if the end point of a training program is to have improved and facilitated a previously learned task, repeated hands-on practice to correct errors and gain speed in the overall procedure is the mainstay of training. This is true because one cannot become an expert surgeon if there is little chance of observing and performing surgical techniques. In other words, the "see one do one" approach no longer holds any benefits for teaching complex procedures [6].

In a study to evaluate the effect of modeling on learning a simple surgical procedure, Custers et al. [6] found that repeating a task could increase speed and decrease overall time. However, improvement in speed was not consistent between each consecutive procedure. According to

Lumsdaine's study (1961), there is no universal agreement about the "saturation point" at which no learning benefits would be acquired despite increasing the number of demonstrations. It must be emphasized that the number of demonstrations required to reach the saturation point varies based on individual learning curve and the quality of learning model.

In the second stepwise training method, residents are given the opportunity to learn outside of the operating room without working on real patients [7]. In pre-patient training programs, trainees can gather knowledge about a specific medical condition and perform procedures using different learning models without any hazards to patients [5].

Surgical skill centers are a good example of such training opportunities. Live animals, bench model simulation, fresh human cadavers, and virtual reality are used for teaching in these centers. With any of these methods, the advantages of pre-patient training in surgical skill centers are the improvement of training efficacy, the opportunity of multiple practice, an educational rather than clinical base program, and better use of operating room learning time [7, 8]. As a part of surgical curricula, training in a surgical skill center calls for high fidelity models, faculty mentors, and adequate time, all of which translate into strong faculty support and a bigger budget [9].

Two types of learning models were compared in this study. The treatment group had the opportunity to learn the parotidectomy procedure in a pre-patient situation through multiple practices, whereas the control group followed a step-by-step program in the operating room. As the resulting analysis indicates, the treatment group had significantly better results than the control group. From the first through the fifth cadaver dissection procedure, the treatment group showed a significant improvement in the time spent finding the facial nerve trunk. Besides the skills and knowledge acquired from pre-patient cadaver dissection, the treatment group reported a higher level of self-confidence than that expressed by the control group. All of these factors allowed the treatment group to better manage the overall procedure in the operating room.

The results of this study are parallel to those of Blandin, Proteau and Alain which indicate that hands-on practice produces a more valuable cognitive representation of the task than simple observation. As evidence of this, members of the control group were unable to perform the total procedure by themselves within the time limitation set by the study.

For developing countries, where establishing virtual reality learning laboratories may be expensive, cadaver dissection remains the best method of surgical training. Cadavers are true anatomy simulators on which advanced surgery may be performed. However, it must be

emphasized that the poor compliance of cadaveric tissue is the most important disadvantage that could limit their use. In addition, they may be more expensive in some countries [10]. In any case, the cost of using cadavers in our country remains considerably lower than that of establishing fully equipped surgical skill centers.

In this study, working on cadavers provided trainees with the opportunity of performing facial nerve dissection without the fear of possible nerve paralysis. There were also the benefits of learning by error and correction outside the operating room along with the prospect of eventually decreasing the overall time spent in surgery on real patients. This insured patient safety and more efficient learning time in the operating room. In addition, the trainers could determine which residents have the psychomotor confidence to perform surgery without any complications.

Conclusion

Each university has a different surgical learning program based on available technology. Needless to say, mastering surgical procedures by trial and error on real patients is not condoned by most universities and, for this reason, surgical simulation as an adjunct to the actual operating room offers many advantages. Additionally, in such a program, trainers can better identify those residents who have mastered the knowledge and skills necessary to successfully operate. Furthermore, trainees can acquire the surgical judgment to decisively handle any unexpected situation and so preserve patient safety. In our study, the positive results of the

cadaver dissection program on the psychomotor skills of trainees in the theater room further demonstrate the impact of a well-designed surgical skill curriculum on a residency program.

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