Office-Based Laryngology: Technical and Visual Optimization by Patient-Positioning Maneuvers

Ameer Ghodke, MS; Douglas R. Farquhar, MD; Robert A. Buckmire, MD; Rupali N. Shah, MD

Objective/Hypothesis: To qualitatively and quantitatively assess the effect of discrete head postures/maneuvers during flexible laryngoscopy on visualization of specific anatomical structures within the laryngopharynx.

Study Design: Prospective, observational study.

Methods: Flexible laryngoscopy was performed on 18 sequential patients. Videos of the laryngopharynx were captured during the neutral head position and five discrete maneuvers: maximal sniffing, head extension, right turn, left turn, and chin down. Images were analyzed using ImageJ, and differences in the (normalized) anatomical areas of interest were examined with each maneuver (paired t test). Covariates for surgeon, nostril, and gender were evaluated.

Results: There was a significantly increased (P = 0.009) area of view of the anterior space (petiole of epiglottis/anterior laryngeal vestibule) with head extension. Right head turn led to a significantly increased view of the left pyriform sinus (P = 0.00001), whereas left head turn yielded an increased view of the right pyriform sinus (P = 0.0001). The right and left vocal fold/ventricle were better visualized during right head turn (with the scope traversing the right nostril) and left head turn (with the scope traversing the left nostril), respectively. Chin-down posture achieved a more distal view of the airway more frequently than the other maneuvers.

Conclusion: The anterior space (supraglottic larynx) may be best visualized and accessed with head extension. Right and left head turn improve visualization of the contralateral piriform sinus. Chin down provides improved airway visualization in a plurality of patients. Future studies examining maneuvers are warranted to create a catalog of validated techniques to optimize the efficacy of the office-based proceduralist.

Key Words: Visualization, in-office laryngology, flexible laryngoscopy, patient-positioning.

Level of Evidence: 2

INTRODUCTION

Examination of the larynx through direct observation is critical to diagnose and treat patients with laryngeal disorders. The development of high-quality distal chip flexible laryngoscopes has significantly improved awake; in-office visualization; and by extension, diagnostic accuracy.1 Additional advances in instrumentation, local anesthetic techniques, and flexible laser fiber technology have potentiated the growing popularity of in-office treatment of laryngeal disorders in awake, non-sedated patients. This transition in turn has led to improved cost-effectiveness of treatment and increased patient satisfaction.2–5

Maneuvers designed to optimize visualization of specific laryngopharyngeal regions have been described previously in the ear, nose, and throat literature across several modalities. In one of the first reports, Killian notes changes in visualization of the larynx during indirect laryngoscopy when the patient is asked to bend the head forward.6 For improved computed tomography visualization of the piriform sinus and retrocricoid area, Hillel and Schwartz described the trumpet maneuver designed to insufflate the pharynx.7 For laryngoscopy, multiple manipulations have been described for improved laryngopharyngeal exposure.8–10 Tsunoda et al. described a head torsion method to visualize the laryngeal ventricle and inferior surface of the vocal fold.11 In patients with an oblique larynx, this maneuver was also found to improve insertion of the endoscope without obstruction of the epiglottis. Additionally, combinations of anterior traction, head torsion, insufflation, Valsalva, and chin-to-chest positioning have all been utilized to optimize laryngopharyngeal visualization during flexible laryngoscopy.8–10,12,13

In the era of increasing in-office procedures, predictable transnasal, flexible endoscopic access to specific regions of interest take on additional therapeutic implications over and above their diagnostic value. Generally, these tricks of the trade have remained in the realm of experiences and trial and error for each endoscopist. In this investigation, we endeavored to examine, characterize, and quantify the effect of specific patient-positioning...
maneuvers on visualization of specific laryngopharyngeal regions of interest. By providing a catalog of maneuvers and their known effect, we aim to add knowledge that may improve technical proficiency and ultimately improve the efficiency and outcomes of these office-based procedures. With ability to perform these procedures with more ease, patient access, outcomes, and cost to the larger medical community may be enhanced.

MATERIALS AND METHODS
Eighteen sequential patients were enrolled in a prospective, observational study. Flexible laryngoscopy was performed with the tip of the endoscope to maintain its relative position at the superior tip of the epiglottis. Videos of the laryngopharynx were captured during the neutral head position and five discrete maneuvers: maximal sniffing, head extension, right head turn, left head turn, and chin down (See Fig. 1). Images were analyzed using ImageJ software (National Institutes of Health [NIH], Bethesda, MD) using a modified technique14 to quantify the areas of interest, which included the anterior space (petiole of epiglottis/anterior laryngeal vestibule), the right and left vocal fold (including medial surface) and ventricle, the right and left piriform sinus, and the proximal trachea. The specific areas to be traced and analyzed by ImageJ software (NIH) were defined and confirmed by the senior authors (RAB, RNS) (see Fig. 2). Regions of interest were examined during each maneuver and compared using paired t test. The areas of interest in each position were compared to the same patient’s baseline neutral head position image to account for differences in viewing distances between patients. Furthermore, the degree of airway/tracheal visualization was graded categorically based on subjective analysis of how distally the maneuver could provide a view. Airways were graded as a 1, 2, or 3 based on a subglottic view, anterior cricoid view, or a tracheal view, respectively.

Exclusion/Inclusion
Patients scheduled as part of their routine standard of care for diagnostic flexible laryngoscopy or for in-office laryngology procedure were recruited for participation in the study. Patients excluded after enrollment were those who could not physically perform the proposed maneuvers due to intolerance, discomfort, or disability. Furthermore, patient data was excluded if review of video images revealed no visibility of the true vocal fold, which served as a quantitative standardization value. The senior authors (RAB, RNS) performed all flexible laryngoscopy procedures.

Data Collection/Statistical Analysis
Individual videos of the laryngopharynx during normal quiet breathing were recorded for each maneuver performed by the patient. Still images were captured from these videos during the inspiratory phase and further analyzed within ImageJ software (NIH). Each area of interest as described above was measured in pixels and presented as a ratio over the length of true vocal fold in pixels. This ratio was used to compare differences between each maneuver and the neutral head position (paired t test). Covariates for surgeon, side of nasal passage used for scope insertion, and gender were compared using a t test. All statistical analyses were calculated using Stata 15 (v. 15.1; Stata-Corp, College Station, TX).

RESULTS
Population Demographics
Of the 18 patients included, the mean age was 59.0 years (standard deviation [SD] 16.0, range 22–75). The cohort was 72.2% male (n = 13) and 27.8% female (n = 5) and was 94% Caucasian (n = 17). The average body mass index (BMI) was 28.2 (SD 7.4, range 18.2–47.5). There were no significant differences in the anatomic area calculations between male and female patients.

Supraglottis and Hypopharynx
There was a significantly increased area of view of the anterior space (petiole of epiglottis/anterior laryngeal vestibule) with head extension compared to neutral head position (See Fig. 2). There was a significantly increased area of view of the left piriform sinus (P = 0.00001) with right head turn compared to neutral head position. Similarly, there was a significantly increased area of view of the right piriform sinus (P = 0.00010) with left head turn compared to neutral head position. There were no statistically significant differences with regard to the nostril used or surgeon for these measurements.

Vocal Fold/Ventricle
The right head turn trended toward a greater visualization of the right vocal fold/ventricle (+2.4%) versus the left vocal fold/ventricle (−11.9%). Specifically, with the right nasal passage insertion of scope, the right head turn maneuver provided an even greater view (+4.5%) of the right vocal fold/ventricle versus entrance through the left nasal passage (−1.9%).

The left head turn trended toward a greater visualization of the left vocal fold/ventricle (+11.5%) versus the right vocal fold/ventricle (+6.9%). Similarly, left nasal passage insertion of scope with left head turn maneuver provided an even greater view (+26.0%) of the left vocal fold/ventricle versus the right nostril (+4.3%). However, none of these findings reached statistical significance. Although there were visible trends, no discrete head position showed a statistically significant improved view of the right or left vocal fold/ventricle.

Airway Visualization
Chin-down posture achieved the most distal (tracheal) view of the airway most frequently (35% of patients) compared to other maneuvers. There was no statistically significant difference related to the specific nostril used.

DISCUSSION
Office-based laryngology has made tremendous strides in the last 2 years. Technological advances in laser delivery systems and distal chip laryngoscopes with working channels paired with increases in the number of
fellowship trained laryngologists have led to significant improvement in the ability to perform in-office laryngology procedures. The multiple advantages of in-office laryngology procedures include but are not limited to the avoidance of general anesthesia and its associated risks, good patient tolerance, and reduced cost.2,3,5 Despite these benefits, given the limited ability to manipulate anatomy, office-based procedures continue to be challenged by obtaining adequate exposure.3

In the past, several maneuvers and postures have been described to facilitate visualization of the upper aerodigestive tract. We embarked on this investigation with the expressed desire to define and quantify the relative effect of commonly used head positions as it relates to specific regions of interest within the laryngopharynx. It seems plausible that a series of head positions and maneuvers can be utilized during the clinical examination and/or unsedated office-based procedure to optimally access specific regions of interest within the laryngopharynx. The appropriate utilization of these maneuvers should aid clinicians in both the diagnoses and treatment of laryngeal disorders.

Although a frequently overlooked area of the larynx, primarily due to the tangential view via both flexible and rigid laryngoscopy, the supraglottic structures present a unique access challenge. This region is difficult to expose and manipulate directly even during suspension laryngoscopy. Our data revealed a significantly increased

---

**Fig. 1. A.** Representative images of the head maneuvers performed by patients. B. Examples of ImageJ software illustrations to calculate ratios of specific anatomical areas (shaded) over length of true vocal fold. The airway was subjectively ranked according to visibility during the procedure.
exposure of the anterior supraglottic region (anterior space) with a head extension maneuver. This is an example of a position that is rarely utilized in our standard clinic endoscopy routine but may prove helpful in specific instances.

Previously, Tsunoda et al. reported improved visualization of a lateralized laryngeal lesion with a contralateral nasal insertion of the laryngoscope. With the addition of a head turn maneuver, however, our data suggests greater ipsilateral vocal fold and ventricular exposure with an ipsilateral head turn and the scope passed through the same-sided nasal passage in comparison to the contralateral nare. This finding, although intriguing, did not reach statistical significance, likely due to insufficient sample size. It does, however, deserve further study and confirmation due to its potential to enhance clinic laryngoscopy through office-based procedural access and treatment of the medial surface of the vocal fold and ventricle. This access is frequently needed in the treatment of conditions that affect this area, such as recurrent respiratory papillomatosis.

Similar to Tsunoda et al., we found greater visibility of the piriform sinuses with a head turn to the contralateral side. However, our data did not confirm added benefit in visualizing of the contralateral piriform sinus by using the opposite nostril versus the ipsilateral side. It is likely that the head turn maneuver has a much greater proportional effect on visualization.

Airway visualization is a frequent challenge to clinical laryngoscopy. Clinically, it is needed to evaluate subglottic or tracheal disease such as stenosis. Airway visualization is also necessary when performing in-office steroid injection of subglottic stenosis or transcricothyroid vocal fold augmentation approaches. We quantified changes in airway visualization associated with the various head maneuvers. According to our data, the most consistent distal view of the airway was achieved with the chin-down position, yielding the greatest degree of airway exposure in 35% of all participants than all other positions. Interestingly, right and left turns also provided improved distal airway exposure over a neutral head position.

The primary limitation of our study is a small sample size that lacks population diversity. The small sample size limits our ability to account for differences involving variations in patient demographics, including gender, race, and BMI. Additionally, our study population consisted of patients already undergoing treatment for laryngopharyngeal pathology rather than a randomly selected cohort, which may have skewed our normative data. In this pilot study, we found evidence of improved visualization of targeted laryngopharyngeal structures with specific patient-positioning maneuvers. Confirmatory studies are needed with a larger and more diverse study sample. The studied maneuvers were based on the clinical experience of two fellowship-trained laryngologists with a robust experience in office-based procedures. These maneuvers and targeted structures could easily be expanded on in future studies to further optimize diagnostic laryngoscopy and surgical access in the awake, unsedated patient and ideally optimize outcomes for these increasingly performed office-based procedures.

Fig. 2. Key findings measuring the change in area over length of true vocal fold from neutral position to left turn, right turn, head extension, or chin down in pixels. *Key finding that is discussed within the scope of the article.
CONCLUSION

The anterior space (supraglottic larynx) may be best visualized and potentially accessed with head extension during flexible laryngoscopy. Right and left head turn improve visualization of the contralateral piriform sinus. Chin-down head posture provides improved airway visualization in a plurality of patients. Future studies examining these maneuvers and others are warranted to create a dynamic catalog of validated techniques designed to optimize the efficacy of the office-based proceduralist.

BIBLIOGRAPHY