**Head and Neck Position for Direct Laryngoscopy**

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Proper positioning of the head and neck is essential for optimal laryngeal visualization during direct laryngoscopy (DL). Inadequate positioning may result in prolonged or failed tracheal intubation attempts because of the inability to visualize the larynx. The sniffing position (SP) is traditionally recommended as the standard head position for optimal glottic exposure. This review was conducted to examine the evidence from the available literature about head and neck positioning for DL. Advocates of the SP maintain that it aligns the oral, pharyngeal, and laryngeal axes, allowing the line of vision to fall directly on the laryngeal inlet. Concerns about the anatomical soundness of the three axes alignment theory (TAAT) were raised, however, during the last decade. Subsequently, the superiority of the SP over other head and neck positions was also questioned. Furthermore, it was found that elevating the head higher than what is needed for a conventional SP may improve laryngeal exposure in some patients. The paucity of clinical research that attempted to investigate the optimal head position for DL is surprising, considering the frequency with which the technique is performed and the complications that may result from difficult laryngeal visualization. The overall goal of this review is to increase the awareness of some preventable technical errors that may lead to poor visualization and that may occasionally result in failure of tracheal intubation.

**DEFINITION OF THE SP**

In 1936, Sir Ivan Magill recommended placing a pillow under the occiput to raise the head and then to extend it to achieve the best laryngeal exposure. He was the first to describe the optimal head position for DL as the position the head assumes when one wishes to sniff the air. Bannister and Macbeth then introduced the TAAT in 1944 to explain the anatomical reasoning behind the superiority of SP. The authors demonstrated in a series of diagrams and radiographs that neck flexion aligns the pharyngeal and laryngeal axes, and head extension at the atlantooccipital joint aligns the oral axis with these 2 axes allowing the line of vision to fall on the glottis (Fig. 1). These pioneers, however, did not specify the degree of neck flexion or the height to which the head should be elevated to reproduce the desired position. Later, Horton et al measured the angle of neck flexion and that of head extension that resulted in best laryngeal exposure. The mode value of neck flexion angle was 35° and that of plane of the face extension was –15° to the horizontal (Fig. 2). The authors also measured head elevation when the desired position was achieved. The head had to be raised between 31 and 71 mm (with a mean value of 55 mm) for optimal exposure. This was measured, however, in subjects with no expected airway difficulty. Unfortunately, there was no mention of the angles or head heights from the 9 subjects with difficult airway. This report has established a standard definition as well as the end points for correct head positioning to achieve a proper SP. Although this definition can be used to...
compare the results from the different studies, it may be of limited clinical usefulness because an angle-measuring device is not usually available in the operating room. The question of how high the head should be raised in patients with difficult airways (when head positioning is most relevant) was also left unanswered. It has been suggested that horizontal alignment of the external auditory meatus with the sternum may be a useful clinical end point to ensure a proper SP and subsequently improve laryngeal visualization in obese patients. Recently, Greenland et al. performed a magnetic resonance imaging (MRI) study to evaluate the external auditory meatus–sternal notch relationship as a marker that indicates a proper SP. The authors examined MRI sagittal slices that were taken starting from the external auditory meatus laterally through the midline plane medially with the head either in the neutral or SP in 10 awake volunteers. They found better axes alignment in the SP. The study also confirmed that horizontal alignment of the external auditory meatus with the sternum can be used as an end point for a proper SP (Fig. 3).

**Head and Neck Position and Laryngeal Exposure: What Evidence Do We Have?**

Since the early recommendations, the SP has always been considered the optimal head position for DL and the TAAT provided the anatomical explanation for its superiority. These recommendations, however, were based on clinical observations, experience, and logic and not on actual clinical studies. It is surprising that for almost 70 years only a few studies addressed the issue scientifically. The paucity of clinical investigations may reflect the widespread acceptance of the TAAT and SP as established facts beyond questioning. During the last decade, however, these “facts” have been investigated, and the conclusions from the different studies resulted in a heated debate.

**Evidence Challenging the SP and TAAT**

Fifty-five years after the introduction of the TAAT, Adnet et al. questioned its anatomical soundness when they could not find axes alignment in a radiograph obtained during intubation in the SP. The authors doubted the original illustrations by Bannister and Macbeth and concluded that the theory is just an anatomical myth. Benu-11 however, criticized the authors’ comments and attributed their inability to observe the alignment to their failure to position the subject’s head in a proper SP. The neck flexion angle in the radiograph used was barely 5°. Had the authors placed the head in a proper SP, they could have observed the alignment. To prove their point, Adnet et al. performed an MRI study in 8 awake volunteers with the head in the neutral, simple extension, or SP. They could not find axes alignment in any of the studied positions and concluded that achieving this alignment is anatomically impossible.12 This study again was criticized because the subjects were awake volunteers. No anesthesia was administered and no laryngoscopy or tracheal intubation performed.13 Although the SP may not result in complete axes alignment in awake subjects, DL in anesthetized subjects achieves this goal, and it does this best in the SP.14 Neck flexion, head extension, and laryngoscopy are all needed for complete alignment. Kitamura et al. supported this statement when they found that DL induced a craniofacial structural arrangement that facilitated laryngeal exposure in anesthetized patients more in the SP than with other
head positions. To address these points, Adnet et al.\textsuperscript{16} conducted a subsequent study to compare the DL views in anesthetized subjects with the head either in simple extension or SP. The authors found no significant advantage in the SP when compared with simple head extension for tracheal intubation. They found the SP, however, advantageous in obese patients and in patients with limited head extension. Again, this study was criticized because of design flaws that made the results inconclusive. Among these flaws were the failure to place the head in a proper SP,\textsuperscript{17} avoidance of neuromuscular blocking drugs that could have affected the laryngoscopic views, and the unblinded nature of the study.\textsuperscript{18} The most powerful argument against the authors’ conclusions was that the authors could not prove the inferiority of the SP.\textsuperscript{6} On the contrary, their data proved its superiority in obese patients and in patients with limited head extension. Perhaps a less than optimal positioning would not pose any problems when performing DL for tracheal intubation in patients with normal airways. Head position would be most relevant, however, in patients with difficult airways, whether anticipated or not, similar to the 2 groups of patients mentioned by the authors.\textsuperscript{16}

**Alternative Theories to Explain the Superiority of the SP**

In addition to the TAAT, 3 other theories have been proposed to explain the superiority of the SP. Chou and Wu\textsuperscript{20} pointed out that the TAAT described the airway as a line or a surface, whereas it is actually a space. It also did not include start or end points for the 3 axes. They recommended excluding the laryngeal axis and considering only the oral and pharyngeal axes with the larynx as the end point of the pharyngeal axis. Isono\textsuperscript{6} proposed the “obstacle theory” to explain the benefit of the SP. He indicated that 2 obstacles anterior and posterior to the oral airway prevent the line of vision from reaching the glottis. Head elevation in the SP moves both obstacles upward, its extension moves the posterior obstacles downward, and laryngoscopy moves the anterior obstacles upward and caudad allowing the line of vision to pass through the created space. Recently, Greenland et al.\textsuperscript{21} performed an MRI study in 42 normal adult volunteers to evaluate the airway configuration in the neutral, extension, head lift, and SP. They proposed a 2-curve theory, wherein the airway is divided into 2 curves: a primary oropharyngeal curve and a secondary pharyngo-gloto-tracheal curve. The authors found a reduction in the area between the line of sight and the airway curve in the SP compared with the neutral position. They proposed the 2-curve theory, rather than the TAAT, as an explanation for the superiority of the SP. It is to be noted that none of these alternative theories denied the superiority of the SP; on the contrary, they all endorsed its use. They were only proposed to provide alternative explanations, other than the TAAT, for its superiority. However, the TAAT is still considered to be the correct anatomical explanation by the majority who argue that even if the SP does not bring complete alignment on its own, it brings the axes as close as possible in preparation for complete alignment to be achieved by the laryngoscope blade.\textsuperscript{14} Lastly, doubting the anatomical soundness of any of these theories does not mean that the SP is not the best position for DL. It only means that there are different opinions on the explanation of its superiority.

**Evidence Supporting the Use of SP**

Hochman et al.\textsuperscript{22} studied the effect of blade size and head position on the force required for optimal laryngeal exposure. Head elevation increased the incidence of full laryngeal exposure with the least required force. Although the
authors called this position the “flexion-flexion” position, their illustration clearly revealed a position similar to the standard SP with the external auditory meatus horizontally aligned with the sternum. In another study, Levitan et al.23 performed DL with the Henderson laryngoscope straight blade to determine the effect of head elevation on the quality of laryngeal view in 7 fresh human cadavers. Laryngoscopy was initiated with the head-flat, then the head was progressively elevated by the laryngoscopist’s right hand until maximal elevation was achieved. The laryngeal views were imaged and later analyzed in the head-flat, full-elevation, and mid-elevation positions. Percentage of glottic opening scores increased from 31% in the head-flat position to 64% in the mid-elevation position to 87% with maximal elevation. Although the study indicated that head elevation improves laryngeal visualization if the exposure was difficult in the head-flat position was thus not investigated. To specifically address this point, Schmitt and Mang5 investigated the effect of head elevation in 21 patients with difficult visualization placed in the SP. When difficult visualization was encountered, head elevation, optimal external laryngeal manipulation, and an increase in the laryngoscope lifting force were simultaneously performed to improve the view. Head elevation improved laryngeal visualization in 19 patients, and maximal elevation beyond the SP enabled cord visualization in 6 patients. Again, although the study illustrated that head elevation, in general, improves visualization, it is not known whether optimal external laryngeal manipulation and the increase in the lifting force had contributed to this improvement or not, nor to what extent. In another study, Lee et al.24 examined laryngeal exposure in the head-flat position and in the 25° back-up position in 40 non-obese adult patients. The authors reported an improvement in the percentage of glottic opening score from 42.2% in the head-flat position to 66.8% in the back-up position. The 25° back-up position was also found, in another study, to improve laryngeal exposure in obese patients and was recommended as an alternative to placing blankets or other devices under the upper body.9 Recently, Park et al.25 compared the laryngoscopic views in the neutral position and with different pillows of 3-, 6-, and 9-cm heights in 50 adult patients. Each patient acted as his/her own control. The laryngoscopic view with 9-cm elevation was superior to that achieved in the other groups. In 5 patients who had short necks, however, the view was better with either the 3- or 6-cm elevation pillows. The authors found significant correlation between neck length and the pillow height needed to provide the best view. In another recent study, 10 awake volunteers had MRI scans of the head placed in both the neutral and SP.10 Unlike the Adnet et al.16 study, a proper SP was verified by using the accepted end point (flexing the neck 35° and extending the head 15°). The authors reported better alignment of the axes in the SP (Fig. 3). The study also showed that when the end point of the SP was achieved, the external auditory meatus was horizontally aligned with the sternum, providing the imaging proof for using this clinical marker as an end point for correct positioning.

In view of the strong criticism against the studies that challenged the use of SP and the weight of evidence from the multiple studies that favored its use, it is safe to conclude that the preponderance of evidence is in favor of using the SP for DL.

**Head and Neck Position for DL in Specific Patient Populations**

As noted by Park et al.,25 the head elevation needed to reproduce the correct SP may vary from one individual to another depending on neck length. Other factors that may control the head elevation height are the anteroposterior diameter of the chest and the size and shape of the head in relation to the chest.

**Obese Patients**

Head elevation in the supine obese patient does not alone guarantee a proper SP.26 In this patient population, the anteroposterior diameter of the chest is increased so that it is almost impossible to obtain a neck flexion angle of 35° unless the shoulders and upper torso are also raised (Fig. 4). The so-called “ramped” position can be achieved either by a stack of blankets or by using one of the commercially available pillows designed for this purpose. Collins et al.27 studied the laryngeal view in 60 obese patients with and without the ramped position and found a statistically significant improvement in the laryngeal view in the ramped position. Another way of recontouring
Optimal positioning before laryngoscopy is essential for clear visualization of the airway. The sternum should be used as an end point for correct horizontal alignment of the external auditory meatus. In obese patients, additional head elevation is required. The Troop Elevation Pillow (Mercury Medical, Clearwater, FL) has been successfully used to facilitate proper positioning before laryngoscopy in obese and large-framed patients. Head sagging decreases the angle of neck flexion and results in a partial supine position (SP). An uncompressible head support is preferred to maintain the desired degree of elevation.

**Head and Neck Position for DL: Technical Considerations**

Although the available literature supports the use of SP, it clearly indicates that some technical errors may be responsible for the erroneous interpretation of its lack of superiority. Review of the literature highlighted the importance of considering the following points to obtain the best possible exposure with DL:

- Placing a blanket under the head does not ensure a proper SP. The head should be elevated so that the angle of neck flexion is 35°. The height of head support needed to achieve this degree of flexion may vary from one individual to another depending on head and neck anatomy and its relationship with the chest diameter. In most instances, a 7- to 9-cm head elevation is required. Head extension at the atlantooccipital joint is required for the proper position (Fig. 6).

**Pediatrics**

Infants and young children have a larger head and smaller chest diameter relative to the adult patient. This anatomical relationship allows optimal visualization when the head is positioned flat on the bed. No neck elevation is needed because a proper neck flexion angle is achieved and only a slight extension at the atlantooccipital joint is required for axes alignment (Fig. 5). Viallet et al. studied the effect of head posture on axes alignment in infants and young children. MRI head scans from 30 subjects were evaluated either in the neutral or simple extension positions. Slight head extension was found to improve the alignment of the line of vision with the laryngeal axis. Older children may require some head elevation to achieve a proper SP. The literature is very scarce on the subject of head posture for laryngoscopy in pediatrics, and it is not precisely known at which age head elevation should be instituted. Because of an even larger head size, a hydrocephalic baby may have extreme head flexion when the head is positioned flat. In this situation, the shoulders and upper body (and not the head) should be elevated to achieve the proper position (Fig. 6).

- Elevating the head 7 to 9 cm in obese patients does not result in achievement of SP. Adequate padding should be placed to support and raise the upper back, shoulders, head, and neck. This can be accomplished by using either a stack of blankets or one of the commercially available elevation pillows (Fig. 7) to position the patient in the so-called “ramped” position. The Troop Elevation Pillow (Mercury Medical, Clearwater, FL) has been successfully used to facilitate proper positioning before laryngoscopy in obese and large-framed patients. Similar pillows, such as the Oxford Head Elevating Laryngoscopy Pillow (Alma Medical, Oxford, UK), are also available in the United Kingdom. The Rapid Airway Management Positioner (AirPal, Center Valley, PA) is an inflatable pillow that has been also used successfully for the same purpose.

- If these devices are not available, then a stack of blankets should be placed on the operating room table before positioning the patient and then adjusted to achieve the desired position. Alternatively, adjusting the operating table to a 25° back-up position has been found to achieve the same purpose. Horizontal alignment of the external auditory meatus with the sternum should be observed before anesthesia induction.

- The SP has 2 components, neck flexion (achieved by head elevation) and head extension. Head elevation alone is not sufficient to achieve a proper SP. The head must also be extended at the atlantooccipital joint.
Failure to extend the head in patients with limited neck extension may result in poor visualization.35 Head elevation is useful because it increases atlanto-occipital angulation, allowing more extension than that with lower head positions.36

- DL may result in a poor glottic view in some patients despite the use of the SP. Elevating the head higher than what is needed for a conventional SP was found to improve visualization in some patients.5,23
- Although the SP is considered the optimal head position for DL, it does not guarantee a perfect exposure in all patients.37 Many other factors interact to affect the final degree of exposure. These factors include the type and size of the blade,38 laryngoscope lifting force,39 operator experience,40 and most importantly, the patient’s airway anatomy.41 Although multiple maneuvers may be used to improve the view, adjusting the head position is recommended as an early remedial step in situations of difficult exposure.42
- Finally, the elevation height that yields the best exposure is not, and should not be, the same for all patients because it depends on the particular head and neck anatomy as well as chest dimensions. It is therefore recommended to consider DL a dynamic procedure and to adjust the head position to obtain the best view when it is unfavorable in the SP.43

In summary, the literature supports the use of the SP for best laryngeal exposure with DL. No evidence was found in the literature indicating the inferiority of the SP, and most evidence found it superior to other positions. Proper positioning should always be verified by observing the horizontal alignment of the external auditory meatus and sternum. Head elevation beyond the SP may improve visualization in a subgroup of patients who have a poor view in the SP. Attention to details during positioning is instrumental in avoiding the technical errors that may affect the resultant view. DL is a dynamic process that should start with properly positioning the patient in the SP, but may require further position adjustment in search for the best exposure.

DISCLOSURES
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REFERENCES

Sniffing Position


17. Benumof JL. Comparison of intubating positions: the end point for position should be measured. Anesthesiology 2002;97:757–61


19. Khorasani A, Candido KD, Saatee S, Ghaleb AH. To “sniff” or not to “sniff”: that is the question. Anesthesiology 2002;97:752–3


36. Chen TH. Sniffing position: an easy way to carry out, not a glottis exposure guarantee. Anaesthesiology 2002;97:750


42. Murphy MF. Bringing the larynx into view: a piece of the puzzle. Ann Emerg Med 2003;41:338–41