

# Determination of Proper Depth of insertion for a Polyurethane High Volume Low Pressure Cuffed Endotracheal Tube: Traditional vs. Topographic Method

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## Background

The traditional depth of insertion of an endotracheal tube (ETT) has been reported to be 21 cm for women and 23 cm for men<sup>1</sup> (21/23 method). Recent reports have suggested this depth may not be adequate for all patients and can result in endobronchial intubation. The introduction of a high-volume low-pressure (HVLP) polyurethane ETTs to healthcare facilities raises the question if the 21/23 method will provide a safe tracheal position for the patient with this style tube (Figure 1). A recently evaluated method (topographical) has been demonstrated to be superior to the 21/23 method.<sup>2</sup> The primary objective of this study was to compare two methods for the placement of a HVLP polyurethane cuffed ETT and to describe complications.

## Methods

This was a prospective, internally-controlled study of 100 ASA physical status I-II patients scheduled for elective surgery with general anesthesia and requiring endotracheal intubation. Intubation with an ETT was initially positioned and taped at a depth of 21 cm or 23 cm, measured at the incisors, for females and males respectively. The ETT tip to carina distance was then fiber-optically measured, and the tube tip was repositioned to our ideal distance (4 cm proximal to the carina).

Additionally, anatomical topographical measurements were obtained by adding the distance from the corner of the mouth to the mandibular angle plus the mandibular angle to the manubrium center at the sternal notch (Figure 2). This measurement was recorded and compared to both the 21/23 method and our measured ideal tip-to carina distance.

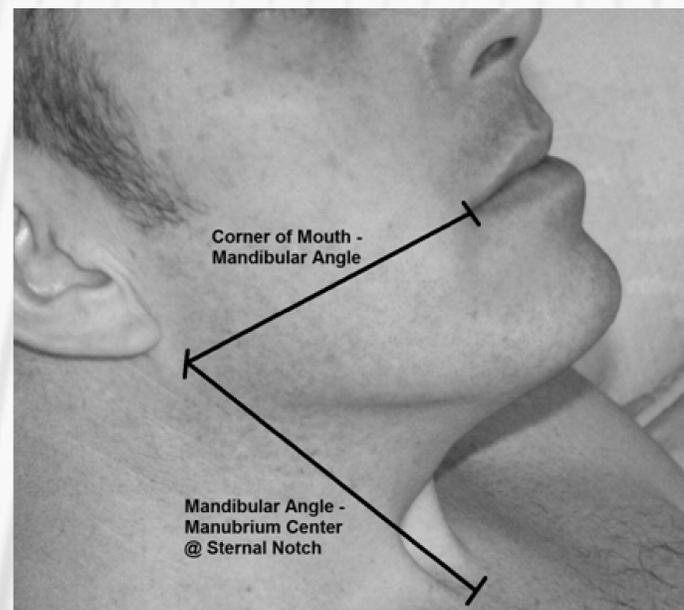


**Fig. 3 Ideal Position** Patient specific, oral commissure-to-carina distance was measured via fiber-optic bronchoscopy. The ETT depth was then adjusted to the "ideal" insertion depth (ETT tip = 4 cm proximal to the carina)<sup>3</sup> and secured. ETT length is standard for each size. At ideal placement the proximal end of ETT aligns with its length in cm + 4 cm on the bronchoscope measurement scale.

**Figure 1: Kimberly Clark Microcuff Endotracheal tube used in this study**



**Figure 2: Topographical Measurements Used to Determine Endotracheal Tube Insertion Depth**



**Fig. 2:** The topographical method is performed by summation of two measurements: 1) the distance from the corner of the mouth to the mandibular angle and 2) the distance from the mandibular angle to the manubrium center at the sternal notch.

**Table 1. Distance of HVLP ETT measured at patients lips by method**

Gender	21/23 (cm)	Topographical (cm)	Ideal (cm)	P-value
Female	21	20.3 ± 1.8	19.9 ± 1.4	21/23 vs. Topo: <0.001 21/23 vs. Ideal: <0.001 Topo vs. Ideal: 0.131
Male	23	21.3 ± 1.6	21.7 ± 1.4	21/23 vs. Topo: 0.017 21/23 vs. Ideal: <0.001 Topo vs. Ideal: 0.253

Results are expressed as mean ± SD; A p < 0.05 is statistically significant.  
Topo= Topographical Measurements

**Table 2: Shift of ETT placement after flexing and extending neck**

Post- Flexion (cm)	P-value	Post- Extension (cm)	P-value
1.7 (1, 0-4.5)	<0.001	1.8 (1, 0-5)	<0.001

Results are expressed as Mean (Median, range)  
A p value <0.05 is statistically significant

## Results

Thirty-seven of 100 ETT tips were located too close to the carina (<3 cm above the carina) following the 21/23 intubation method. Proper insertion depth (cm) to produce our ideal tip to carina position was 19.9 ± 1.4 and 21.7 ± 1.4 (mean ± SD) for women and men respectively (Table 1). When we compared the topographical measurements (20.3 ± 1.8 cm in women, and 21.3 ± 1.6 cm in men) to our ideal ETT position our data revealed no significant difference in either men or women (P = 0.131 and P = 0.253, respectively), confirming safety and accuracy of this method. Flexion and extension of the neck produced significant shifts from the initial position of the ETT (1.7 and 1.8 cm, respectively; Table 2).

## Conclusion

The HVLP polyurethane ETTs have a thinner cuff leading to additional mobility. For this style tube, the topographical method is superior in estimating the ideal ETT insertion depth compared to the 21/23 method. This style ETT also migrates in each direction with flexion and extension of the neck. Based on our data, we suggest to insert polyurethane cuffed ETTs to 20/21 cm for women and men respectively for a more appropriate tracheal position.

## References

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