Accuracy of Fingerbreadth Measurements for Thyromental Distance Estimates: A Brief Report

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There have been many contradicting studies as to how well preoperative airway assessments predict difficult intubation. One of these measures, thyromental distance (TMD), has often been called into question. However, there have been no published studies evaluating whether anesthesia practitioners are measuring TMD accurately, especially if they use fingerbreadths as opposed to a centimeter ruler.

A convenience sample of 60 anesthesia providers were asked to participate in a brief study. The subjects were asked a series of questions, including the type of anesthesia provider they were, how often they used TMD, and their estimates in centimeters of the following fingerbreadth combinations: index finger, index and second finger, index plus second and third fingers, and index plus second, third, and fourth fingers. After their estimates were recorded, exact measurements of the fingerbreadth combinations were made at the distal interphalangeal (DIP) joints.

The differences between the means of the estimated and the actual measurements were analyzed using an independent t test. There was a statistically significant difference between estimated and actual fingerbreadth measurement for the index finger ($P < .006$) but not for the combinations of fingers.

Keywords: Difficult intubation, fingerbreadth measurement, preoperative airway assessment, thyromental distance.

Thyromental distance (TMD) is a measurement used to determine the horizontal distance between the thyroid prominence and the inner surface of the mandible when the head and neck are fully extended and the mouth is closed.[1] This assessment is currently used to aid in the evaluation of the airway before endotracheal intubation. Preinduction measurement of thyromental distance is important, because during direct visual laryngoscopy (DVL) the tongue is displaced by the laryngoscope into the thyromental distance space.[1] If the TMD is short, there is less space for tongue compression by the laryngoscope blade. In that case, visualization of the glottis and/or vocal cords can be difficult or impossible, potentially resulting in failed intubation. A TMD of less than 6 cm is generally accepted as a predictor for difficult DVL. However, few research studies agree on this measurement. In a study conducted by Tse et al,[2] the minimum TMD predictor was considered to be less than 7 cm. Iohom and coworkers,[3] in their study, thought a TMD of less than 6.5 cm was the predictor of choice. El-Ganzouri et al[4] used a TMD of under 6 cm as a predictor of difficult DVL, and Ayoub et al[5] suggested a cutoff point of 4 cm.

Anesthetists frequently measure the TMD by using a clear ruler marked in centimeters or, more conveniently, by using fingerbreadths. The later measurement is made by placing the first, second, and third fingers between the thyroid prominence and the mandible.

Many anesthetists do not know the measurement of their first (index), second, and third fingers at the distal interphalangeal (DIP) joint. As a result, the anesthetist could make an inaccurate assessment and could be surprised by an inability to establish or maintain an airway after induction. This could result in a delay of surgery, airway trauma, brain damage, or even death.

The purpose of this study was to assess anesthesia providers' estimated and actual fingerbreadth measurements to determine the effectiveness of the practice of using fingerbreadths as a measuring tool for thyromental distance.

Methods

Approval for the study was obtained from both the hospital's and the university's institutional review boards. A convenience sample of 60 anesthesia practitioners, including anesthesiologists, Certified Registered Nurse Anesthetists (CRNAs), and student nurse anesthetists, were asked to participate. After signing an informed consent, the subjects were asked a series of questions. These included the type of anesthesia provider they were (anesthesiologist, CRNA, or student nurse anesthetist), how often they used TMD measurement in their practice (daily, several times a week, rarely, never), and their estimates in centimeters of the following finger combinations: index; index plus second; index, second, and third; and index, second, third, and fourth. Each subject's re-

sponse was recorded on the survey tool. Each subject was then asked to place his or her hand on the back of the survey tool, and marks were made at either side of each DIP joint. The orientation of the hand was noted as an aid in measurement. The exact measurements of the distances recorded on the back of the survey tool were made with a clear centimeter ruler. The data were recorded in a statistical software database (SPSS version 15, SPSS, Chicago, Illinois) and contained descriptions of provider type, gender, frequency of use of fingerbreadths, stated finger measurements, and actual finger measurements. An independent *t* test was used to determine if a statistically significant difference existed between estimated and actual fingerbreadths.

Results

A total of 60 anesthesia providers, 22 men and 38 women, agreed to participate in the study. Table 1 shows the provider type and how often they used TMD in their preoperative airway assessment. Table 2 shows the stated and actual finger measurements. As can be seen, there was a variation between the stated and actual measurements of TMD. The subjects' estimates of fingerbreadth measurements varied more than did the actual measurements.

	Number	Percent
Student (n = 15)		
Daily	12	80.0
Several times a week	2	13.3
Rarely	1	6.7
CRNA (n = 37)		
Daily	17	45.9
Several times a week	12	32.4
Rarely	8	21.6
Anesthesiologist (n = 8)		
Daily	1	12.5
Several times a week	3	37.5
Rarely	3	37.5
Never	1	12.5

Table 1. Provider Type and Use of TMD Measurement
TMD indicates thyromental distance; CRNA, Certified Registered Nurse Anesthetist.

The independent-samples *t* test was used to analyze the differences between the stated and actual measurements for all finger combinations. The results showed that there was a significant difference between the stated and the actual measurement of the index finger at the DIP joint ($P < .006$; Table 3). However, data from the other 3 finger combinations revealed no significant difference between the estimated and actual measurements.

Discussion

Although the data showed that there was no statistically significant difference between stated and actual measurements of the fingerbreadths except for the index finger, none of the anesthesia providers actually knew the measurements of their fingerbreadths. This may be a reason for the reported variance in accuracy and specificity with TMD measurements, as described by Butler and Dhara,[6] el-Gansouri et al,[4] and Iohom and colleagues,[3] who reported sensitivities between 7% and 25% and positive predictive values between 16% and 38.5%. (Sensitivity indicates the ability of TMD to correctly identify difficulty of DVL. Positive predictive value indicates the percentage of patients whose TMD measurement predicted a difficult intubation and who actually had a difficult intubation.)

Additionally, anesthesia practitioners may not have read or remembered the literature regarding TMD measurement. These factors could have resulted in practitioners who not only did not know the accuracy of the measurements they were documenting but also did not know exactly what they were measuring or its importance. This could set the stage for an unexpected difficult intubation during anesthesia induction. A closed claims analysis by Caplan et al[7] found that nearly 34% (522 of 1,541) of the claims made against anesthesia providers were associated with respiratory events. Of these 522 cases, 444 (85%) were associated with brain damage or death.

A study by Rose and Cohen[8] suggested that a TMD measurement of less than 3 fingerbreadths was significantly associated with difficult intubation ($P \leq .01$). However, they did not specify the actual fingerbreadth measurements or the TMD.

Arné et al,[9] in a study of 1,200 patients, found that using a cutoff point for TMD of 6.5 cm, when combined with a multifactor assessment, decreased the incidence of

	Index finger		Index and middle fingers		Index, middle, and ring fingers		Index, middle, ring, and little fingers	
Measurement (cm)	Est	Actual	Est	Actual	Est	Actual	Est	Actual
Mean	1.56	1.82	3.35	3.65	5.25	5.40	7.08	7.08
Minimum	.80	1.40	1.60	2.70	2.40	4.20	3.00	5.50
Maximum	5.00	2.50	10.00	5.00	15.00	7.00	20.00	10.00

Table 2. Estimated and Actual Fingerbreadth Measurements of TMD in Sample (n = 60)
TMD indicates thyromental distance; Est, estimated.

Estimated measurement vs actual measurement (by finger)	t Test for equity of means				
	Equal variances	t	df	Significance 2-tailed	Mean difference
Index	Equal variances assumed	−2.85	118	.005	−.26
	Equal variances not assumed	−2.85	72.16	.006	−.26
Index and middle	Equal variances assumed	−1.61	118	.11	−.29
	Equal variances not assumed	−1.61	75.43	.11	−.29
Index, middle, and ring	Equal variances assumed	−.57	118	.57	−.15
	Equal variances not assumed	−.57	71.64	.57	−.15
Index, middle, ring, and little	Equal variances assumed	.16	118	.87	.06
	Equal variances not assumed	.16	69.34	.87	.06

Table 3. Independent Samples *t* Test for Estimated and Actual Measurements

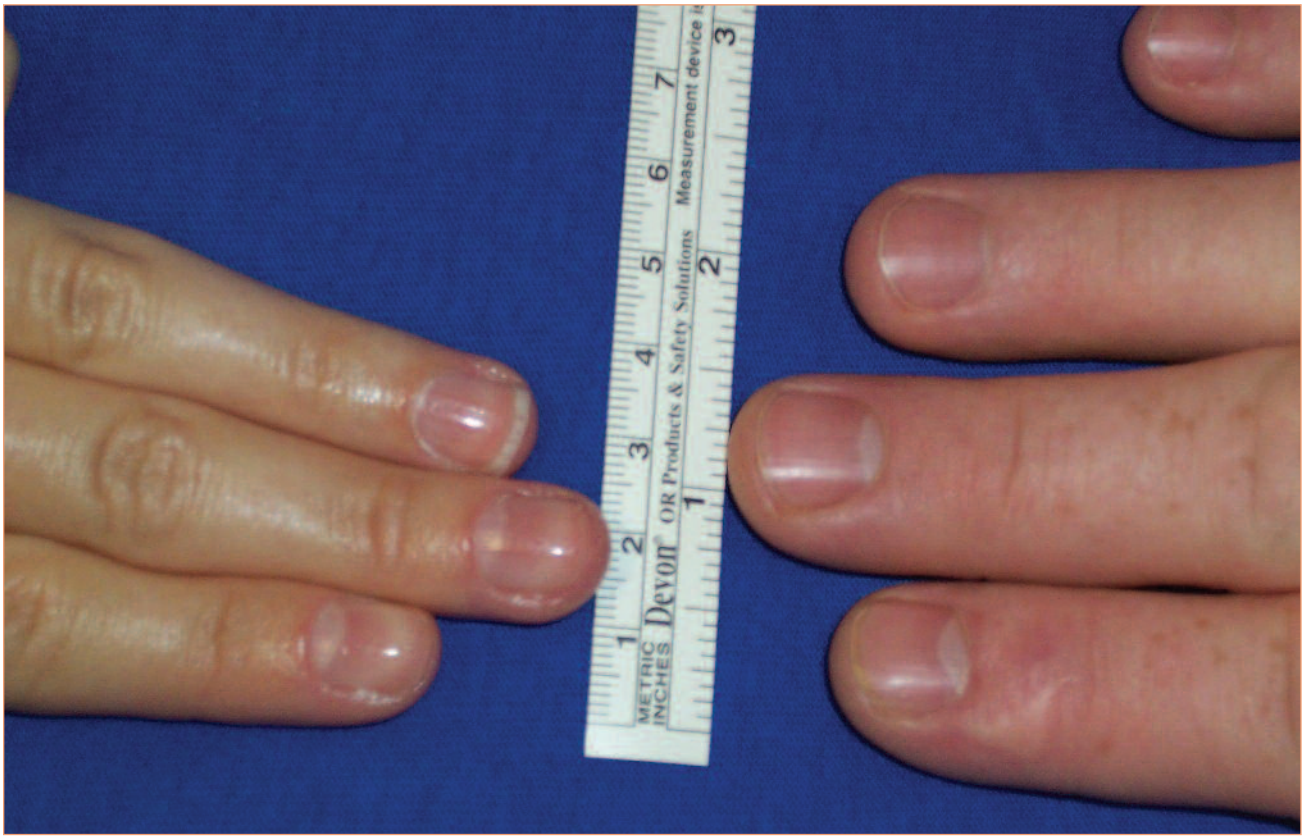

Figure. Fingerbreadth Measurements Vary by Size of Fingers
The person with the larger hand (at right) had an actual index finger measurement of 2.50 cm and an index, middle, and ring finger combination of 6.7 cm. The person with the smaller hand had an index finger measurement of 1.4 cm and an index, middle, ring, *and little* finger combination of 4.2 cm.

unexpected difficult intubation to 0.2%. It seems prudent that the anesthesia provider use a multifactorial knowledge-driven preoperative assessment to develop primary and backup plans for securing the airway.

The data from the current study (see Table 2) suggest that use of all 4 fingers might be an adequate negative predictor for those with narrow fingers, while the use of 3 fingers would be more than adequate for those with larger hands (Figure). An understanding of one's own fingerbreadths, through actual measurement in centimeters,

will allow the anesthesia provider to be better prepared for encountering a difficult airway. These measurements should be updated as the anesthetist gains or loses weight.

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