

**Original Article****Morphometric analysis of human trachea in adult in Gujarat region by luminal cast Plastination**

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**ABSTRACT**

**Background:** The trachea makes a significant portion of the conducting airways. In addition to its vital role in breathing, variations in the anatomy of the trachea between individuals could have significant importance in clinics.

**Objective:** To obtain values of length and diameter of human trachea.

**Material and Methods:** The Length, antero-posterior and transverse diameters of the trachea were measured on 28 cast of trachea prepared by luminal cast Plastination in the anatomy department of B. J. medical college of Ahmedabad, Gujarat, India.

**Result:** The maximum length of trachea was 10.59 cm and minimum was 8.51 cm. The mean length of trachea was 9.37 cm. The maximum anteroposterior diameter of trachea was 2.25 cm and minimum was 1.16 cm. The mean anteroposterior diameter of trachea was 1.70 cm. The maximum transverse diameter of trachea was 2.1 cm and minimum was 1.42 cm. The mean transverse diameter of trachea was 1.78 cm.

**Conclusion:** Knowledge of the diameter and length of the trachea is essential in the proper selection of endotracheal tube size used for delivery of anaesthetic gases during general anaesthesia. In addition, this knowledge aids clinicians in choosing the proper size of tracheostomy tubes used in emergency situations.

**Key words:** Trachea, Luminal cast Plastination, Tracheobronchial tree cast

**INTRODUCTION**

The trachea makes a significant portion of the conducting airways. In addition to its vital role in breathing, variations in the anatomy of the trachea between individuals could have significant importance in clinics [1]. The trachea is a centrally located membrano-cartilaginous unpaired hollow organ extending downwards as a continuation of the larynx from a vulnerable superficial position in the neck deep into the well-protected middle of the mediastinum [2]. The trachea extends from the lower border of cricoid cartilage opposite C6 vertebra up to the upper border of T5 vertebra where it ends by dividing into right and left principal bronchi supplying the right and left lungs respectively [3]. Changes in tracheal dimensions occur in a variety of conditions. For example, generalized widening is a characteristic feature of tracheobronchomegaly and tracheomalacia; generalized narrowing is seen in tracheobronchopathia osteochondroplastica and may be a feature of relapsing polychondritis. Knowledge of normal tracheal dimensions on conventional chest radiographs is essential to the diagnosis of these conditions. The knowledge of length and diameters of human trachea has

potential application in conduction of endotracheal intubation (diagnostic and/or therapeutic) with skill and perfection.

**Objective:** To obtain values of length and diameter of human trachea.

**MATERIAL AND METHODS**

The present study involved the use of human lungs, collected from post mortem room and also from the embalmed bodies from the department of anatomy, B. J. Medical College, Ahmedabad of 35 to 60 years of age during period of October 2011 to November 2013.

**Materials:**

Material used in present study is

- Human lungs
- Silicone gel tube with its gun
- Acids (hydrochloric acid or sulphuric acid)
- Detergent
- Dissection instruments
- Vernier calipers
- Glass jars

**Procedure:** A clear plastic cannula was placed into larynx lumen and ligated in place. The trachea was flushed with running tap water. Then it was irrigated with mild detergent solution to remove the mucous plugs. The flushing procedure was repeated 5 to 10 times, until the majority of mucous and blood was removed. Silicone gel was injected in trachea with help of gun. The cannula of silicone gel was introduced directly into larynx and gel was pushed into the lungs to near capacity. During this filling process, it gradually becomes more difficult to inject the silicone gel into the airways. Therefore care was taken not to over fill the lungs or rupture the airways by gentle and continual pressure applied to the plunger of the gun. The silicone gel was allowed to harden overnight. The next day, the lungs were placed in a jar containing HCL. Once most of the parenchyma was removed by acid, Tracheo-bronchial cast (figure 1) was taken out from acid and rinsed with running tap water to remove any remaining loose tissue [4].

Later the measurements were taken as follows:

1. Tracheal length: It was measured from the lower end of cricoid cartilage impression to the apex of subcarinal angle where the trachea was bifurcating was taken with the help of Vernier callipers.
2. Tracheal diameter: The diameter at the upper end of trachea just below the impression of cricoid cartilage was taken with the help of Vernier calipers.



**Tracheobronchial tree cast**

## RESULTS

Present study was done on 28 tracheobronchial tree casts of 35 to 70 years of age, out of which 24 were male and 4 were from female cadavers.

The observations are as follows.

**Table 1: Length of trachea in study subjects**

sex	No. Of subjects	Range (min-max) (cm)	Mean (cm)	± SD (cm)
Male	24	8.61-10.59	9.45	0.56
Female	04	8.51-9.11	8.87	0.26
Total	28	8.51-10.59	9.37	0.56

**Table 2: AP and transverse diameter of trachea**

sex	N	AP diameter		Transverse diameter	
		Range (min-max) (cm)	Mean (cm)	Range (min-max) (cm)	Mean (cm)
Male	24	1.16-2.25	1.75	1.42-2.1	1.8
Female	4	1.27-1.47	1.36	1.59-1.73	1.67
Total	28	1.16-2.25	1.7	1.42-2.1	1.78

## Discussion

### Tracheal length:

**Table 3: Comparison of tracheal length**

Authors	Tracheal length (cm)	
Strenberg S[5]	11	
Rosen FS[6]	6.58	
Leader JK[7]	7.86+/-1.68	
Chunder R et al.[8]	Male	41-55
	(Yrs.) > 55	10.69
	Female	41-55
	(Yrs.) > 55	9.53
Mrudula C.[9]	7.87	
Present study	9.37	

### Tracheal Diameter:

#### Transverse Diameter

According to Hampton T. et al. the MEAN±SD of transverse diameter of the trachea was 1.75±0.26 cm [10]. According to Chunder R et al. the average internal transverse diameter of upper trachea was 1.24 cm, 1.22cm and lower trachea was 1.2 cm, 1.1 cm in males and females in 26-40 years age respectively [8]. According to Mrudula C. [9], Strenberg S. [5] transverse diameter was 1.99cm, 2- 2.5 cm respectively. In present study average transverse diameter of trachea was 1.72cm.

#### AP Diameter:

According to Chunder R et al. The average AP diameter of upper trachea was 1.9 cm, 0.9 cm in males and females in more than 55 years age

respectively [8]. In present study average AP diameter of trachea was 1.7 cm.

The transverse and anteroposterior diameter in present study was slightly lower than other studies may be due to fact that the diameters found in dissection or radiology method was external diameter means it included tracheal wall whereas in present study internal diameter was measured from casts prepared by luminal cast Plastination method.

### LIMITATIONS OF THE STUDY

Present study shows measurements of internal diameter as compared to other studies which shows external diameters of trachea. Because of some limitations in obtaining samples during our study duration and our procedure for preparing luminal cast was lengthy so we have less number of samples and high male to female ratio.

### CONCLUSION

We found the mean length of trachea was 9.37 cm. The mean antero-posterior diameter of trachea was 1.70 cm. The mean transverse diameter of trachea was 1.78 cm. Knowledge of the diameter and length of the trachea is essential in the proper selection of endotracheal tube size used for delivery of anaesthetic gases during general anaesthesia. In addition, this knowledge aids clinicians in choosing the proper size of tracheostomy tubes used in emergency situations.

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