

# A MORPHOMETRIC ANALYSIS OF FOURTH VENTRICAL OF HUMAN CADAVERIC BRAIN BY PLASTINATION

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## ABSTRACT

The fourth ventricle enlarges in various conditions like hydrocephalus, dementias, mutism etc. So, it is necessary to know the normal range of dimensions of fourth ventricle. Present study was conducted at anatomy Dept. P.D.U. medical college, Rajkot, Gujarat during October 2009 to October 2010. The casts of ventricular system of 20 formalinized cadaveric human brains were prepared after injecting epoxyresin+hardener (BOND TITE) mixture. From the cast, measurements of height (from upper end of impression of superior medullary valum to obex) and breadth (at the level of lateral recesses) of 4<sup>th</sup> ventricle were taken by vernier caliper. The data was analyzed statistically and was compared with the data obtained from radiological methods. In present study, the mean height of fourth ventricle 2.29 cm (range 1.9-2.7cm, S.D. 0.30) and mean breadth 2.38 cm (range 1.75-3 cm, S.D. 0.44). Present data differs significantly from data of radiological studies, which could be due to different methodologies, whereas the radiological methods are indirect and two dimensional; the present study with cast gives direct and three dimensional results without distorting the dimensions of fourth ventricle.

**Key-words:** 4<sup>th</sup> Ventricle, Plastination, Luminal cast, Morphometry

## INTRODUCTION

The brain undergoes many gross and pathological changes with advancing age, and also in various dementias, with regression of brain tissues<sup>1</sup>. CSF spaces increases in dementia especially in Alzheimer's disease and Parkinson's disease<sup>2, 3</sup>, this can be due to reduction in size of nerve cells<sup>4, 5</sup>. Ventricular enlargement is a more sensitive indicator of cortical atrophy due to increasing age and dementias<sup>6</sup>. The dimensions of fourth ventricle also enlarge in various types of hydrocephalus. Fourth ventricle was found to be significantly larger in the autistic group compared to control group<sup>7</sup>.

A luminal plastination is a technique of preparation of dry, nontoxic, durable cast of hollow cavity within organ to get three dimensional orientation of cavity, which can be used for morphometric analysis.

The aim of present morphometric study is to examine the range of dimensions of the normal fourth ventricular cavity in cadaveric human brain by plastination.

## MATERIAL AND METHODS

Present study was conducted at Department of Anatomy, P.D.U. Medical College, Rajkot, Gujarat, during October 2009 to October 2010. Study sample consisted of 20 human brains obtained from the 10% formalin preserved cadavers following the standard method of dissection described by Cunningham<sup>8</sup>. Arachnoid matter and blood vessels were carefully removed from the surface of brain and six cannulas were gently introduced into the lateral ventricle; each one into the inferior, anterior, and posterior cornu of both lateral ventricles.

Epoxy resin and hardener ('BOND-TITE') were mixed in 2:1 ratio to prepare luminal injection liquid, which was stirred well to ensure thorough admixture of components. Luminal fluid was injected via cannula introduced in any one of the anterior cornu without applying undue pressure; as soon as the injection medium could be observed leaking through another cannula, it was clamped and the same procedure was continued until all cannulas were clamped. After injection, the specimen was kept at room temperature for 48 hours. The brain tissue was dissected very carefully to obtain cast of ventricular system of brain.



**Fig. 1:** Method of injecting luminal fluid into ventricular cavity of brain



**Fig. 2:** Cast of fourth ventricle

In the cast, following measurements of 4<sup>th</sup> ventricle were taken.

1. Height: Height of 4<sup>th</sup> ventricle was measured from the upper end of impression for superior medullary velum to level of obex with vernier caliper.
2. Width: Measured at the level of lateral recesses with vernier caliper.

**RESULTS**

In 4<sup>th</sup> ventricle mean height (mean 2.29 cm) was slightly less than mean width (mean 2.38 cm).

**Table 1:** Measurements of 4th ventricle (in cm)

Measurement	Range	Mean	SD
Height	1.9-2.7	2.29	0.30
Width	1.75-3	2.38	0.44

Appropriate statistical tests were applied and the standard deviation was calculated.

**DISCUSSION:**

Brain regression involving both the cerebrum and the cerebellum usually began by the seventh decade and thereafter accelerated with advancing age<sup>9,10,11,12</sup>. In clinical practice, precise measurements of ventricular size of the brain will be of value.

F.Duffner et al<sup>13</sup>, Dsoza et al<sup>14</sup> and Gawler et al<sup>15</sup> found the mean value of height of 4<sup>th</sup> ventricle 3.83 cm, 1.18 cm and 1.08 cm with MRI, CT and ventriculography respectively. In present study it was 2.29 cm.

F.Duffner et al<sup>13</sup> and Dsoza et al<sup>14</sup> found the mean value of width of 4<sup>th</sup> ventricle 1.25 cm and 1.31 cm with MRI and CT respectively. In present study it was 2.38 cm.

**Table 2:** The comparative measurements of 4th ventricle with other study (in cm)

	Height			Width		
	Range	Mean	SD	Range	Mean	SD
F.Duffner et al.	3.34-4.43	3.83	0.30	1.02-1.64	1.25	0.17
D'souza et al	-	1.18	0.27	-	1.31	0.23
Gawler et al	-	1.08	-	-	-	-
Present study	1.9-2.7	2.29	0.30	1.75-3	2.38	0.44

Mean value of height in present study was less than the value obtained by MRI<sup>13</sup> and more than the value obtained by CT<sup>14</sup> and Ventriculography<sup>15</sup> (Table-2). Table -2 also shows that mean value of width in present study is more than values obtained by MRI<sup>13</sup> and CT<sup>14</sup>.

These disparities in dimensions can be explained on the basis of different methodologies. The radiological methods like CT, MRI, Ventriculography and

Pneumoencephalography are indirect and give two dimensional results and magnification factor may also distort the results. The measurements taken after producing casts are direct one and because of the three dimensional orientation of cast there are less chances of error ensuring more accurate measurements. Injected material used in the present study (Mixture of Epoxy resin & Hardener) was watery in viscosity and curing time of material was long enough about an hour or so, eliminating the need to apply pressure to inject

the material, so the fluid will spread everywhere in ventricular cavity simply due to gravity and it will not distort the dimensions of ventricular cavity and give a nearly accurate results during measurements.

## CONCLUSION

From this study it is evident that Plastination is method of producing cast without pressurized injection and thus it is a three dimensional direct method of morphometric analysis of human 4th ventricle. The present study found mean height of fourth ventricle 2.29 cm (range 1.9-2.7cm, S.D. 0.30) and mean breadth 2.38 cm (range 1.75-3 cm, S.D. 0.44). Difference in measurement between present study and previous radiological study may be due to errors occurring during calculating magnification in CT, MRI and Ventriculography and also because the later studies are indirect and two dimensional.

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