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LUMINAL SILICONE CASTS OF HUMAN AND SHEEP BRAIN VENTRICULAR SYSTEM AS TEACHING TOOLS IN ANATOMY

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ABSTRACT

Background: Medical students studying human gross anatomy have difficulty in conceptualizing the internal three dimensional structure of the brain ventricular system. The students are further challenged with comprehending the orientation and spatial relationship between the different parts of the brain and the ventricles. **Objectives**: To overcome these difficulties and to visualize better the three dimensional structure of ventricles, using silicone casts of human brain ventricular system. To use these casts to teach the anatomy of ventricles and to compare the ventricle system of human and sheep brain to help student understand comparative anatomy. **Methodology**: All purpose silicone sealant was injected into the ventricles of embalmed human and sheep brains. It was then cured, macerated and mounted. **Results:** Complete silicone casts were obtained which were durable and life like replica of the human and sheep brain ventricular system. These casts were used effectively to teach the gross Anatomy of Human ventricles and to teach comparative Anatomy.

Key words: Brain ventricular system, Human and sheep brain, Silicone casts

INTRODUCTION:

The inherent spatial complexity of the human cerebral ventricular system coupled with its deep position within the brain poses a problem for conceptualizing its anatomy. Cadaveric dissection, while considered the gold standard of anatomical learning, may be inadequate for learning the anatomy of the cerebral ventricular system. Even with intricate dissection, ventricular structures remain difficult to observe. Most of anatomical illustrations of brain superimpose an outline of ventricular cavities on the brain: ventricles are seen showing through. However, this kind of illustration is not enough to understand their three dimensional features and relationships. **(1)**

Engaging multiple senses enhances learning. **(2)** The main objective of the study is to make three dimensional real life casts of the brain ventricular system to help the students to understand better the relations of the ventricular system to different parts of the brain. The anatomical accuracy and durability of the casts make them powerful tools in acquisition of knowledge. Comparison of human and sheep brain ventricles gives insight for the students on

comparative Anatomy. The study of comparative Anatomy kindles the interest of students and makes them realize why the humans are more evolved than lower animals.

MATERIALS AND METHODS:

Ethical consideration**:** Instituitional ethical committee clearance has been obtained for the study from SRM Medical College Hospital and Research Center, Kattankulathur,Tamilnadu.

The casting techniques used in this work were based on those of Tompsett.(3) Five freshly harvested sheep (Ovis aries) brain specimens were obtained from The Government College for Veterinary Sciences, Chennai. Five embalmed human cadaveric brains were obtained from the department of Anatomy, SRM Medical College, Kattankulathur. General purpose silicone sealant (M-seal) was injected to prepare the casts. Hand held manual silicone pump was used for injecting silicone.

Preparation:Brain specimens were kept in 10% formaldehyde solution for 3 days to make them firm for easy handling.

Silicone injection:

A one centimeter diameter hole was drilled at the site of central sulcus of human brain using the plastic cannula provided with the silicone sealant. Another one centimeter diameter hole was drilled at the junction of cruciate fissure and superior frontal sulcus of sheep brain using the plastic cannula. The holes were drilled in both the hemispheres. The ventricles were gently flushed with water. The general purpose silicone sealant was mounted on the silicone pump and the cannula was fitted to its nozzle. Silicone was then injected through the holes drilled. Injection was stopped when silicone started oozing out from the fourth ventricle.

Curing: Silicone was allowed to harden at room temperature for 48 hours.

Maceration: The casts were then taken out by removing the brain substance manually. All brain tissues sticking to the casts were removed carefully. The casts thus prepared were boiled in water for 15 minutes to remove the residual tissue sticking to them.

Mounting: The casts were trimmed and pruned. They were then mounted on plastic sheets using thin metal rods for easy handling.

RESULTS:

The casts thus obtained were of excellent quality in terms of flexibility, clarity of details and anatomical accuracy. The three horns of lateral ventricles, the third ventricle, the cerebral aqueduct and the fourth ventricle showed complete filling. The casts were highly durable and anatomically precise.

The human third ventricle shows four recesses namely the optic recess, infundibular recess, pineal recess and supra pineal recess. All these recesses showed complete filling. The fourth ventricle also showed filling of all recesses namely median dorsal recess, two lateral dorsal recesses and two lateral recesses.

DISCUSSION:

The anatomy of the ventricular system of the brain is difficult to fully understand as it is seldom seen in 3D, as is the flow of cerebrospinal fluid (CSF). The luminal plastination of brain ventricles prepared using silicone sealant is a useful tool for students. It is not a supplement to the cadaver teaching. It is only complementary to it. It helps the students to understand the spatial orientation of the brain ventricular system which is otherwise difficult to comprehend three dimensionally.

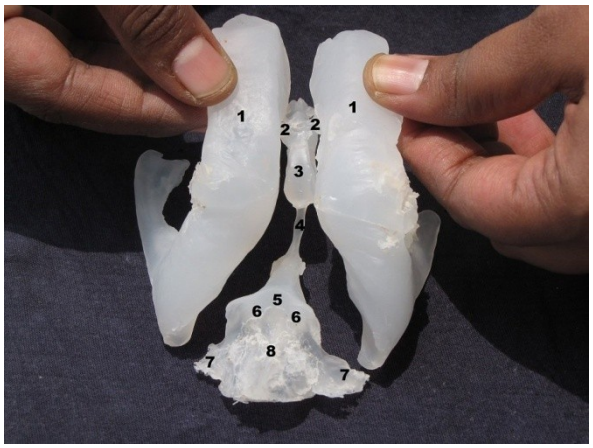
Table 1: Comparison of Human and sheep ventricular silicone casts.

Attribute	Human ventricle cast	Sheep ventricle cast
Orientation	**Vertical**	**Horizontal**
Lateral ventricle	Inferior horn large implying well developed temporal lobe	Inferior horn small implying poorly developed temporal lobe
Third ventricle	Small central defect in cast formed by interthalamic adhesion	Large central defect in cast formed by massa intermedia

Figure 1: Human brain ventricular cast.

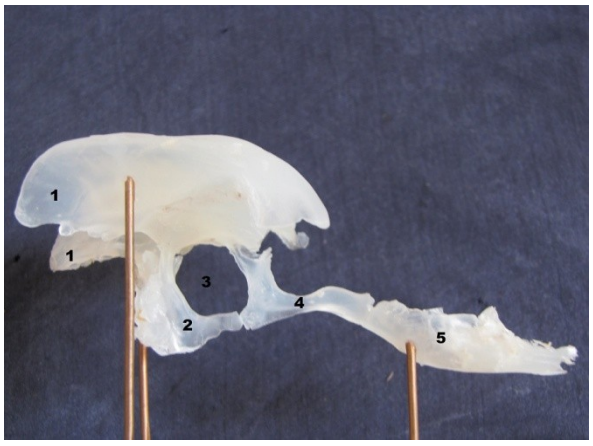
1. Lateral ventricle, 1a. Anterior horn, 1b. Posterior horn, 1c. Inferior horn. 2. Supra optic recess 3.Infundibular recess 4.Third ventricle 5. Inter thalamic adhesion 6.Supra pineal recess 7.Pineal recess 8.Cerebral aqueduct 9.Fourth ventricle.

Figure 2: Human brain ventricular cast



1.Lateral ventricles 2. Interventricular foramen 3. Third ventricle 4. Cerebral aqueduct 5. Median dorsal recess 6. Lateral dorsal recess 7. Lateral recess 8. Fourth ventricle

Figure 3: Sheep ventricle cast



1.Lateral ventricles 2. Third ventricle 3. Massa intermedia 3. Cerebral aqueduct 5. Fourth ventricle

Complete casts of both human **(4)** and sheep **(5)** brain ventricular systems were obtained by the above method. **(3,6.7)**

The lateral ventricles showed complete filling (Fig. 1). The students could trace the impressions produced on the ventricles by surrounding structures like the calcar avis and collateral eminence. This helped in understanding the spatial orientation of posterior horns of the lateral ventricles to calcarine sulcus of occipital lobe and inferior horns to the collateral sulcus of temporal lobes. This also helped us create an insight into the concept of complete sulci of the brain.

The casts of interventricular foramina (Fig. 2), showed the communication between the two lateral ventricles and the third ventricle.

Filling of recesses of third ventricles (Fig. 1) helped to teach the medical undergraduates the relative positions of optic chiasma, infundibulum and pineal gland with respect to the third ventricle.**(8)** In the fourth ventricle (Fig. 2), the filling of lateral recess by silicone, helped the students to comprehend three dimensionally the location of Foramen of Luschka. The median dorsal recess pointed to the location of nodule of cerebellum just caudal to it. The two lateral dorsal recesses on either side of the median dorsal recess indicated the location of inferior medullary velum just inferior to it.

The filling of aqueduct showed the communication between third and fourth ventricles. The cerebral aqueduct showed complete filling in human brain cast.

The casts of human and sheep brain ventricles were compared (Table. 1). The nearly vertical disposition of human ventricles compared to the horizontal orientation of sheep ventricles was evident.

The temporal lobe being poorly developed in sheep (Fig. 3) when compared to the primates was well established by the relatively smaller inferior horn of sheep ventricle casts when compared with the human casts.**(5)**

The third ventricles of human brain casts showed a narrow filling defect for inter thalamic adhesions. However, in sheep brain casts, there was a large filling defect for the massa intermedia where the medial portions of two thalami fuse.

The casts thus obtained can be stored for very long periods of time without any special techniques of preservation. They are cost effective in terms of both preparation and preservation. They are used by the students at any time without soiling the hands. The flow of cerebro spinal fluid is explained in class rooms using the specimens. The medical under graduates of our institution find the cast of brain ventricular system very useful in understanding the three dimentional orientation of the ventricles. This model is suited for both self-directed learning and classroom teaching of the three dimensional anatomical structure and spatial orientation of the ventricles, their communications and their relation to adjacent neural structures.

We hope that organ casting will make a significant contribution to medical education in developing countries like India, being an affordable and easy technique for visualizing anatomical specimens.

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