Innovative museum techniques in enhancing Medical Education: a study on interactive and experiential learning for medical students

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SUMMARY

The anatomy museums that provide students with access to cadaveric specimens and bones for their learning purpose are essential in the field of medical education. It is now mandatory for every medical college to have an anatomy museum. Therefore, for every medical student it will be useful to know about the museum techniques. The purpose of this study was to acquaint medical students with museum technique. To achieve this objective, thord-year medical students of Panimalar medical college hospital and research institute Chennai who came to department of Anatomy for their elective courses were selected for the study. All aspects of museum techniques, starting from specimen preparation using dissected cadavers, and later preservation techniques, preparing jars using acrylic sheet, labelling, mounting of both dry and wet specimens, were taught to the elective students. The students were divided into four groups with five students in each group. The stipulated time used for the study was 15 days. The museum work was divided and given to each group accordingly, and asked the groups to show innovation in mounting specimens. The students learnt all the museum techniques within the stipulated time. They mounted the museum specimens and showed their innovative skills and knowledge. All the steps followed in making museum specimens and jars were photographed, and the procedures were recorded in the log book. The enthusiastic work of the students creates innovation with respect to traditional method of education. The medical students visiting anatomy museums during their first year of the course gives them an idea about human body. Museums are important educational resources, and are considered a supplemental approach in providing medical education. This study has facilitated their independent training in museum techniques, which will help in better comprehension and knowledge enrichment about museum preparation among medical students.

Key words: Anatomy museum – Acrylic sheets – Formalin – Chloroform – Table saw and scale

INTRODUCTION

A museum by definition is “An institution that houses and cares for a collection of artefacts and

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other objects of scientific, artistic or historical importance and makes them available for public viewing through exhibits that may be permanent or temporary". The early museums predominantly comprised paintings and models. This was because the preservative formalin was not discovered until 1859. In 1859, Alexander Mikhailovich Butlerov discovered formaldehyde, which was then isolated in 1868 by August Wilhelm Von Hoffmann as formalin. These have been used as preservatives for the specimens (Kamath et al., 2016).

The museums in a medical institution are the primary resource for teaching Anatomy. The students, by viewing the mounted anatomical specimens, both wet (gross specimens) and dry (bones) models, are provided with a visualized image regarding the human body's structure and organization, which may be difficult to understand from textbooks and lectures. Apart from that, nowadays the museums are important learning tools in medical education, as they help students in self-directed learning; they also develop better communication skills.

The medical students have visited museum but they have not been trained in museum techniques. This study involved the students in preparing jars, mounting specimens, preparing mounting solution and labelling by themselves in order to create an interest in museum-,making among the student community. It aimed to promote the innovation skills or talents of the medical students in museum techniques.

MATERIALS AND METHODS

The study was conducted in Panimalar medical college hospital and research institute for the third-year medical students who came to the department of anatomy for elective course. A total number of 20 medical students opted to study museum techniques. The students were divided into 4 groups (five students in each group).

Group I – Specimen preparation. The specimens were dissected from the embalmed cadavers.

Group II – Preservation technique and preparing mounting solution.

Group III – Mounting technique and labelling.

Group IV – Preparing Museum jars with acrylic sheet.

Specimen preparation

The first step done in the preparation of specimens was selection of the cadavers. The cadavers were collected from the Anatomy dissection hall. Already dissected cadavers by the first-year undergraduate medical students were preferred for the study. The specimens were dissected accordingly for preparation of dry and wet specimens. For making dry specimens, the hyoid bone was dissected out using a scalpel and the bone was removed from the midline of the neck. The dissection steps were followed in accordance with Cunningham's dissection manual, vol. 3, Head & Neck (Romanes, 2001). The procured bone was put in a tray, filled with water and kept for about two days. After two days, the bone was taken and the soft tissue attached to the bone was scraped out using a blunt scalpel, forceps and scissors. The bone was washed well in running water, and with a brush it was cleaned clearly and placed in 5% hydrogen peroxide. Then the bone was kept under the sunlight for two days to get dried. This method was a little time-consuming, but the advantage is that all the features of the bones will be preserved. For making wet specimens, the dissected-out specimens were placed in a bucket filled with 10% formalin.

Preservation technique and preparing mounting solution

The following steps were followed:

1. Fixation: for preserving the specimens, 10% formalin was used as fixative.

2. Restoration of specimen: it is a method that required restoring the natural color of the specimens, as they lose it on fixation. The Kaiserling II method was followed (Pulvertaft, 1950). The neatly dissected specimens were washed in running water and transferred to 95% alcohol for a time from 10 minutes to 1 hour, depending on the size of the specimen. A change of color of the specimen was observed after leaving the specimen in the solution for 1-2 hrs.

3. Preservation of specimen:

Kaiserling III solution: Glycerin – 4 liters, Distilled water – 10 liters, Potassium acetate – 14 grams. The prepared solution was left to stand for 2-3 days to ensure proper mixing of the chemicals (Proger, 1958; Culling et al., 1985).

Mounting technique and labelling

The specimens were mounted on to a center plate made of acrylic sheet measuring about 3mm in thickness. The specimen was stitched on the center plate using nylon threads. Points for stitches were marked using a marker pen on the center plate, and holes of 1/16 inch diameter were made using a drill (Fig. 1 A, B).

In case of dry specimens, labelling was done inside the jar. A coat of amyl acetate and quick fix was applied to the labels. Labelling was also done using acrylic sheets of 1/16 inch in thickness. The labelling was written on these sheets. The sheets were then cemented to the bottom of the center plate or to the bottom of the outer aspect of the jar (Natarajan et al., 2012).

Preparing museum jars with acrylic sheet

Step 1: Measurement of each specimen was taken.

Step 2: Sheets were cut according to the measurement.

Acrylic sheets were cut with a table-saw. A 48-tooth carbide-tipped blade 10 inches in diameter was used for cutting the sheets. The cut edge of the acrylic sheet should be smooth, straight, square to the faces and sharp on the edges, because along this area the glue is applied in order to stick the sheets (Latha V. Prabhu et al., 2015). The edges were trimmed with a router (Fig. 1C).

Step 3: Pasting of sheets using chloroform.

The Chloroform was used as a solvent to bind the cut pieces of acrylic sheets. Methods for using chloroform to bind acrylic sheets:

a) Firstly, the students were asked to follow safety precautions while using chloroform, due to its toxicity. They worked in a well-ventilated area, wearing gloves and eye protection to prevent skin and eye contact.

b) The measured and trimmed acrylic sheets which had to be joined were taken. Its surfaces were cleaned for dust.

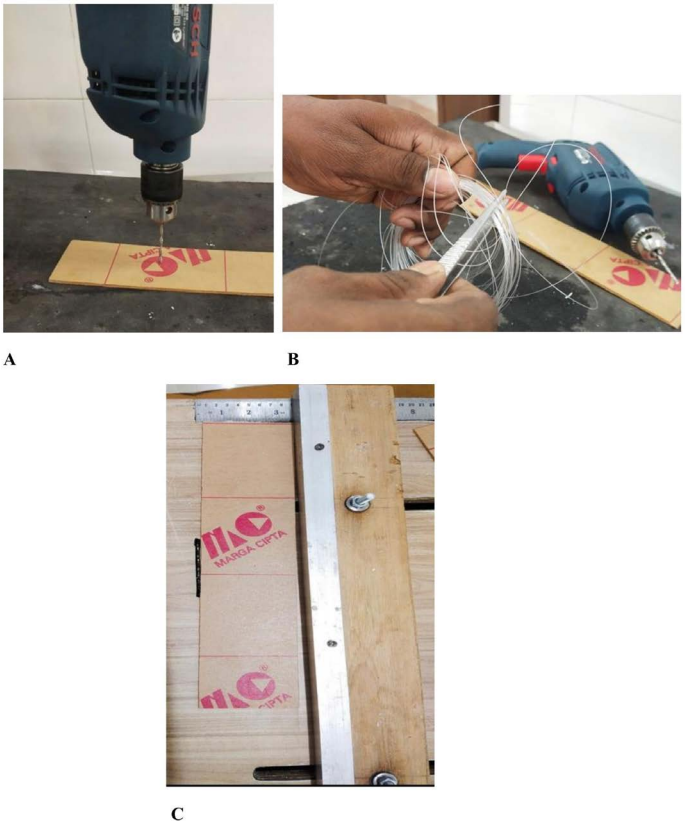

Fig.1.- A. Making hole in the center sheet with a driller. B. Nylon thread for tying the specimens. C. Table saw.

c) The chloroform-acrylic solution was prepared: the scraps of acrylic (small pieces of acrylic sheets) which were obtained during the cutting of the sheets with a saw were dissolved in chloroform. They were mixed well until a syrupy consistency is achieved. The ratio of acrylic to chloroform was used in a 1:10 ratio (scraps of acrylic to chloroform).

d) The prepared solution was applied to one of the surfaces to be joined, ensured even coverage of the solvent (Harris et al., 1977; Brune, 1987). The edges of the acrylic pieces were aligned correctly and joined together (Fig. 2).

Step 4: Drying the jars for sticking of sheets with each other:

After pasting, the jars were allowed to dry. The weights (stone) were kept on the pasted jars to secure the pieces in place. The jars were kept in this position for at least two days to allow the adhesive to dry completely (Fig. 3).

Step 5: Checking for leakage of jars.

Before mounting, the jars were checked for leakage. The leakage was checked using adhesive application method. The chloroform was used as an adhesive to seal the gaps at the joints. To achieve this, the students were asked to hold the jar slantly; a little chloroform was poured along the edges of the jars, and the jars were rotated as the fluid touched the joints of the jar (Azubuike and Onwusi, 2018; Jain et al., 2013; Nim, 2012; Winkelmann, 2007; Domanski et al., 2023).

RESULTS

It was observed that each of the four groups mounted the specimens accordingly as described below:

Group I mounted the spinal cord (wet specimen) and ear ossicles (dry specimen) (Fig. 4).

Group II mounted the hyoid bone and the cartilages of the larynx (dry specimen) (Fig. 5).

Group III mounted the malleus bone (dry specimen with a model depicts the bone) (Fig. 6A, B).

Group IV mounted the incus bone (dry specimen with a model drawing of other bones) (Fig. 6C).

Models form the most important part in the anatomy museum and bring reality to the stu-

Fig. 2.- A. Acrylic scraps. B. Mixing chloroform with acrylic scraps using glass needle. C. Pouring the solvent (adhesive) along the trimmed edges of acrylic sheets. D. Joining/pasting the sheets.

A B

Fig. 3.- A. Weight (stone) kept on the pasted jars. B. After 2-3 days the adhesive got dried and the jar is ready (sticked properly).

dents' imagination of human organs. With the help of the models, the three-dimencional and two-dimensional views of the organs can be demonstrated to the medical students in the museum itself. In the present study, the models are made with the help of Plaster of Paris, wood and thermacol. The students presented the models in an innovative method (Fig.6).

DISCUSSION

The anatomy museum is considered a science museum, because it is not only used by medical students but also by the science students as they display various anatomical structures of the human body. Indirectly or directly, the museum plays an important role in understanding the structure of an organ by visualizing the specimens mount-

A B

Fig. 4.- A. Spinal cord. B. Ear ossicles.

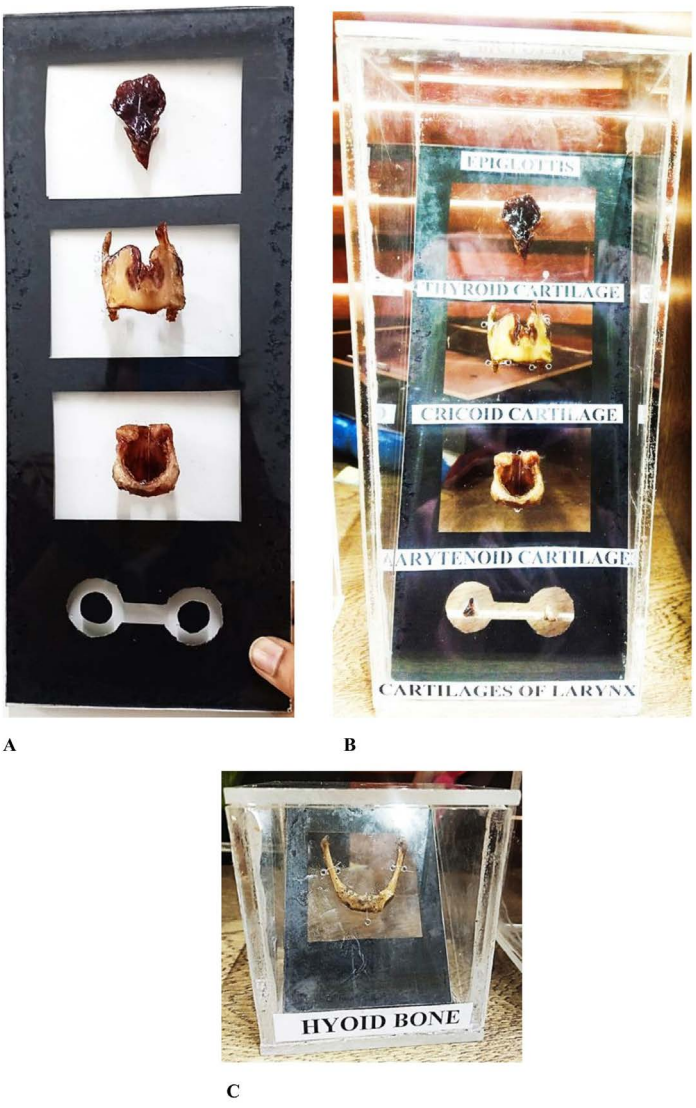

Fig. 5.- A, B. Innovation in mounting cartilages of larynx. C. Hyoid bone.

ed. Nowadays, the students' learning skills have been changed: they are fascinated towards what they see and learn. When they perform all the techniques by themselves, this creates an interest to the medical students and while studying, they get an opportunity to show their innovative ideas. Thereby, the present study may be the first study to incorporate the undergraduate medical students in performing the museum techniques and exploring their innovative technique in mounting the specimens.

Recent CBME curriculum has emphasized the role of anatomy museums, as they contribute to the field of research and education from time immemorial, by understanding the various aspects of human Anatomy (Maraldi et al., 2000). Therefore, the anatomy museum plays a crucial role in the life of the first-year medical students. They get totally exposed to a different world, where their imagination of the human organs is seen really in the museums (Sachin and Darshana, 2020).

Kagan HJ et al. designed a study to explore how an integrative art-museum-based program might benefit 3rd and 4th year medical students. Their results suggest that participants perceive visual arts-based methods as useful for teaching many core competencies in medicine in a novel way compared to traditional scientific-based medical pedagogy (Kagan et al., 2022).

There has been an increasing effort to incorporate fine art education into medical training, primarily to enhance visual perception skills and empathy. Fine art curricula incorporating pattern recognition skills could help enhance diagnostic acumen and efficiency. Deep seeing involves the ability to perceive textures and colors that may not be immediately distinguishable. This can

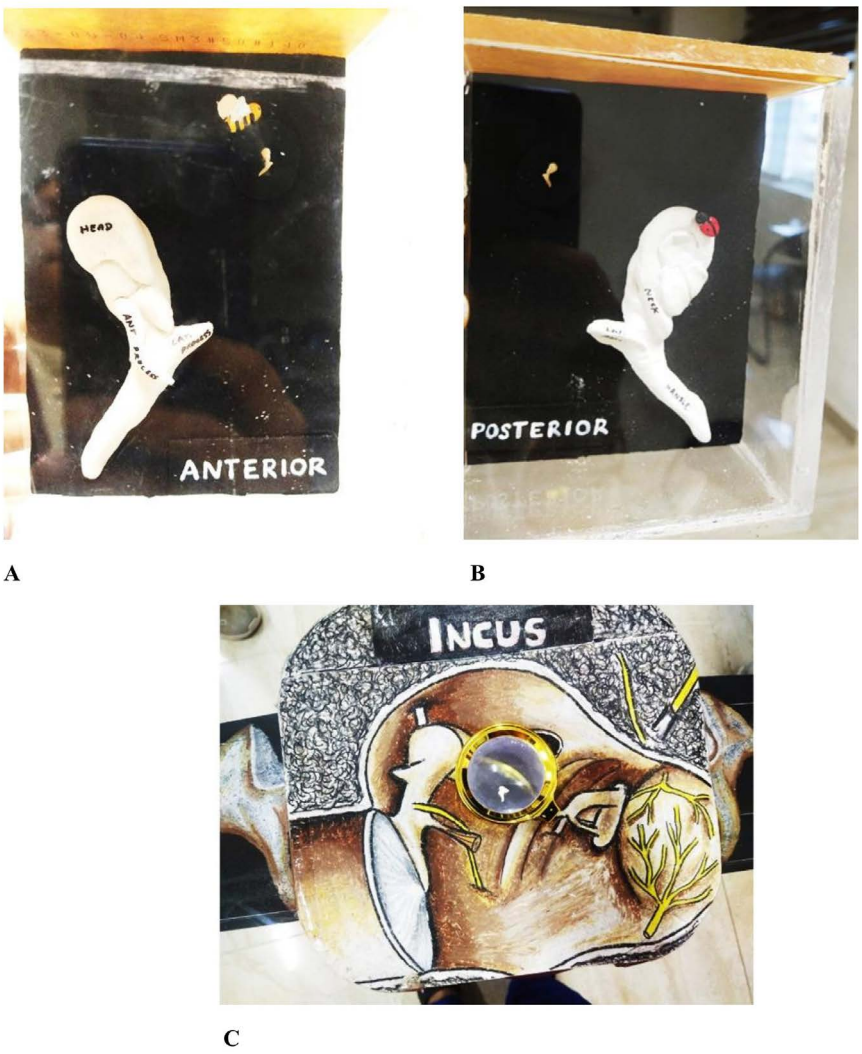

Fig. 6.- A, B. Anterior and posterior view of Malleus bone (dry specimen). Model made of Plaster of Paris shows the markings of the bone. The real bone was pointed in the upper part of the jar by a bug. C. Students' innovation in mounting ear ossicles. The incus bone was focused by a lens.

translate clinically to observing details beyond the most prominent colors and textures. Moreover, with the increasing use of telemedicine, it is important for residents to be able to "see" the textures in the absence of a full physical examination. Interpretation of facial expressions of a painting's subject(s) often helps identify the artist's intention or message. In medicine, similarly, accurate interpretation of facial expressions is likely to enhance empathy and quality of care. The framework of VTS (visual thinking strategies) seems to be effective, and the evidence suggests that instructors comprise both clinicians and art curators. Future efforts would benefit from a standardized curriculum and assessment guidelines (Dalia et al., 2020).

A study was conducted to evaluate whether students' exposure to VTS (visual thinking strategies) would improve their physical observation skills, increase tolerance for ambiguity, and increase interest in learning communication skills. There are about 32 students that attended three 90-minute sessions, at which they observed and commented on three pieces of art in small groups led by museum educators.

Pre- and post-test evaluations included Geller and colleagues' version of Budner's Tolerance of Ambiguity Scale, the Communication Skills Attitudes Scale, and free responses to art and patient images. Students significantly increased their tolerance for ambiguity (P = .033), as well as positive views toward health care professional communication skills (P = .001) (Klugman et al., 2011).

Similarly, another study which conducted a student survey at Leiden University has indicated that all students (100%) found audio-guided

museum tours to be useful for learning, and the majority of them found guided tours to be clinically relevant (87%). However, 69% of students felt that museum visits should be optional rather than compulsory within the medical training curriculum (Marreez et al., 2010).

By heeding the importance of VTS and skill-based study introduced by the NMC (national medical commission) in the CBME curriculum in India, the present study was conducted to the medical students in order to initiate their innovative talents, learning skill and communication skill. The students were very much interested, interactive and intellectual during the study. They showed their innovative talents, which will be useful during their further course of the study.

CONCLUSION

The Competency-based Medical Curriculum adopted by the National Medical Commission in India emphasizes on Self Directed Learning (SDL). Thereby the author believes that creating innovative museums will encourage the students in the learning process in this regard.

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