Plastination Technique Represents a Life in Biological Specimens–An Overview

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Abstract

The dissection of cadavers and gross anatomical observations are acknowledged for a long time as the best way to understand structural configuration of fundamental anatomy in veterinary and medical education. For about 2-3 decades, plastinated specimens are rightly regarded as powerful teaching aids in human and animal’s anatomy across the world at several laboratories and museum exhibitions. However, the use of anatomical models for the education of students (medicine, surgery and fine arts) and teaching of the veterinary anatomy came up with current issues of limited use of animals and various regulations imposed against the availability of cadaveric specimens by institutional animal ethical committee in their course of welfare of human society. Plastinated specimens have promising source of anatomical models with authenticity of anatomical specimens/models in veterinary and medical education in our country.

Keywords: Plastination, Cadavers, Ethical, Models and Plastinates.

1. Introduction

The preserved biological material especially human cadavers majestically lie with several hundred Pyramids in Egyptian Civilization. The Golden pages of history lead to awesome preservation technique which was practiced by Egyptians. It is widely known as mummies which were prepared by mumification. Egyptian was believed that there was a beautiful life after the death too. They thought the human cadavers not only having physical state but also it has moral and immortal status. Egyptian had removed the body fluids and wrapping the cadavers in the linen materials prior to mumification. Then, the wrapped cadavers lay down in a shallow pit in the desert and allowed them in the sunlight for dehydration. It is huge mystical and scientific evidence lies with each pyramid in the Nile Civilization in the present era. Our Indus Civilization depicts with soul immortal in great Epics of Ramayana and Mahabharata. There are several methods for preservation of biological specimens gradually evolved with own pace of scientific development.

The present situation is disposal of human cadavers and pleasantly kept in cryogenic containers without breaking the physical, legal and ethical issues for short duration. Simultaneously, the cadavers/corpses plays an important role in medical education, scientific research or tissue transplantation. With one step ahead that it can be further used as artistic displays in museum and educatory exhibitions. For many centuries scientists have tried to create effective and health safe method of conservation and long lasting preservation of corpses. Mummies and anatomical preparations created in the past have had many pros and cons which is the reason for continuous research today (Sivrev et al., 2005).

The successful preservation of conventional methods by embalmed cadaver s corpse’s are routinely practiced for educational/research purposes. The existing form of preservation technique is not promising to meet the current challenges in the medical, paramedical and veterinary sciences. The embalming fluid causes potential health hazards with continuous exposure (Coleman, 1995). The anatomists are try to find out new alternatives to overcome the various health hazards during handling of embalmed cadavers in institutional teaching of medical and veterinary sciences. The search for newer low-formaldehyde alternatives to cadaveric materials for use in medical colleges will have to surmount the major drawback of lack of basic and practical knowledge on modern innovations as corroborated in a study by Ajao et al. (2010). The cadavers should be eco-friendly nature during demonstration and handling with safety levels of individual health. The cadavers are the only source of teaching tools in the human and
vetinary anatomy and handled regularly by the staff and students in the anatomical laboratory.

The human/Veterinary anatomy has always been one of the most important subjects in the medical/Veterinary sciences. It has been taught with its independence on students to access various cadaverous specimens. There is no little doubt that in the 21st century, students are becoming completely aware about the World Wide Web (www) for acquiring information and to seek additional resources like computer simulation, animated 3D animated images and illustrated graphic pictures (Azu et al., 2012). Over the past decade, the role of anatomical teaching in the undergraduate level has changed considerably with different e-learning based simulations. However, the active dissection of cadaveric specimens is gradually being replaced with alternative resources. It is due to the limited use of animals/cadavers under Institutional Animal Ethical Committee (IAEC) guidelines. As anatomists, we have to modify our attitudes towards the whole process of teaching basic veterinary anatomy specifically on the application of newer methods. Hence, any methodology or technique that would decrease the level of exposure to formaldehyde should be explored. In an attempt to increase motivation and enhance anatomical learning by students in veterinary colleges various methodologies have been introduced by respective faculties across the world. This includes the use of cadaverous embalmed specimens, problem based learning, virtual reality 3-dimensional animated models and other computer based simulations. With the challenge of better preservation methods of cadavers/or specimens and increasing number of newer medical/veterinary colleges both government and private sectors, it would be naive to believe that veterinary colleges would completely abandon the use of cadaveric materials preserved with formalin. The cadavers are major teaching tools that can be introduced by special preservative technique like plastination.

2. Plastination

Plastination is a technique for preservation of biological specimens. It is the most important technique recently developed for the preservation of biological specimens (Hubbell et al, 2002). Palatinates offer this excellent alternative as it lowers the risk of undue exposure to formaldehyde with higher health and safety regulations. A specimen can by anything from a full human cadaver or animals to small piece of organs, parasites. They are known as plastinates. It should be manipulated as per our desirable positioned prior to curing (hardening) of the polymer chains. The water and lipid tissues are replaced by curable polymers. Curable polymers used as silicone, epoxy and polyster–copolymer. The yielding specimens that can be touched, don’t smell or decay and even retain most properties of the original.

The development and positive progress towards the plastination is unimaginable in the teaching, research and cultural values in the deadness. At this point the plastination technique is a combination of science, technological phenomenon and artistic events associated with human civilization of cultural values between life and death. It gives an evident that intention has been to get away from the presenting dead bodies in their deadness (Skulstad, 2007). It appears that many anatomists have not been realized yet the revolutionary significance of plastination for anatomical research. Teachers have accepted plastinated specimens as superior specimens in relation to synthetic models, on account of their ability to reflect anatomical variations. Plastinated cadaverous models were used readily than embalmed formalin fixed cadavers/specimens. Plastinates are more pleasant to touch, did not cause any tearing, respiratory irritations and topical allergy (Menaka et al., 2010).

3. Background

Plastination is a very beneficial study method that is increasingly gaining popularity for its benefits in teaching and research anatomy. Originally the technique was invented and introduced in the medical world by Gunther von Hagens in 1977. As a scientific assistant at the Anatomical Institute of Heidelberg University, Germany, seeking a method to improve the quality of renal specimens in the laboratory. Thereafter, he began to experiments with different types of plastics and finally drawn of great deal with trial and error on many tissues/organs for understanding of basics of plastination. As it we know today the word “Plastination”. He started own company in the name of Biodur after the patent of his plastination technique. He promoted his work further and provided the wide variety of specimens and chemical agents through one supplier. In 1986, the International Society for plastination was founded by him and one year after, The Journal of International Plastination Society was published. He established International Institute of Plastination at Heidelberg to promote his plastination technique and its processed plastinates in 1993 as a research purposes. He invited by Japanese Anatomical Society to exhibit the plastinated models at National Science Museum in Tokyo in 1995. The exhibited plastinates drew a keen attention and interest more than 3 million visitor in the exhibition show. This was the first time displayed the plastinated models publicly for common people. Eventually, he started to participate and exhibit his plastinates to different part of the world as “Body
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4. Principles of Plastination
Plastination methodology consists of slowly replacing tissue fluids and a portion of tissue lipid with a dehydrating agent and replaced with polymer under vacuum chambers. In these processes, water and lipids in biological tissues are replaced by curable polymers ie. Silicone, epoxy resins and polyesters which results in dry, odorless, hard and firm nature of plastinates as similar with natural conditions (Hagens, 1986). Plastinated specimens are dry, durable, odorless and give a true to life appearance. Human plastinated specimens are today’s milestone in medical education and become an ideal teaching tool not only in anatomy but also in pathology, obstetrics, radiology and surgery (Al-Zuhair et al., 1995).

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5. Technical Methodology
There are four steps in standard process of plastination:
- Fixation
- Dehydration
- Forced Impregnation in a vacuum chamber
- Hardening or Curing

5.1 Fixation
The first step of plastination is fixation. Fixation frequently utilizing formaldehyde based solution which serves two main functions. Dissecting the specimens to show specific anatomical elements can be time consuming work. Formaldehyde or other preserving solutions help to prevent decomposition of the tissues. They may also confer a degree of rigidity. This can be beneficial in maintaining the shape or arrangement of a specimen.

5.2 Dehydration
After the proper dissection the specimens are then placed in a bath of acetone. Under freezing conditions, the acetone draws out all the water and replaces it inside the cells. Forced Impregnation of Polymers: The specimen then placed in a bath of liquid polymer such as silicone rubber, polyester or epoxy resin. By creating a vacuum, the acetone is made to boil at a low temperature. As the acetone vaporizes and leaves the cells, it draws the liquid polymer in behind it, leaving a cell filled with liquid plastics.

5.3 Hardening
The plastic must be cured either with gas or ultraviolet rays in order to harden it.

6. Future Scope and Opportunities
The plastinated internal organs are dry odorless, easy to demonstrate the gross morphological details. These specimens can be preserved well to minimize use of animals on humanitarian ground. The plastinates are utilized as teaching aids and anatomical museum models than formalin fumed dripping wet specimens. Present study proved that anatomists can use plastinated cadaver models more readily than formalin fixed /embalmed cadavers (Menaka and Chaurasia, 2015). However, there is positive outlook on the future of plastination with the enthusiasm and interest shown by students, and professionals. There is no doubt that student of various medical/veterinary colleges will be the ultimate beneficiary as this anatomical technique of preservation (using plastinates) becomes more realistically in the virtual learning of anatomy.

References
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