Al Ameen J Med Sci 2016; 9(4):212-214 ● US National Library of Medicine enlisted journal ● ISSN 0974-1143

EDITORIAL CODEN: AAJMBG

Plastination: A novel way of preserving tissues

Ashwini Jadhav*, P.R. Kulkarni and Gayatri Chakre

Department of Anatomy, Dr. Vaishampayan Memorial Government Medical College, Opp. District Court, Solapur-413003 Maharashtra, India

Plastination is a technique or process used to preserve body or body parts without any health hazards like carcinogenicity and contact dermatitis associated with the use of Formalin. The word Plastination is derived from the Greek word "Plassein" meaning 'to shape' or 'to form'.This technique of tissue preservation was invented in 1977 in Heidelberg, Germany by Dr.Gunther Von Hagens who is a German born Physician and Anatomist. He discovered this process in 1977 in a laboratory at the University of Heidelberg while experimenting with Kidney slices and plastic polymers when he came across the technique whereby blood, fat, water and other fluids are replaced by plastic enabling corpse tissue to be preserved for centuries. He displayed his plastinates in a manner in which all internal organs, nerves, blood vessels and bones could be viewed by the public thereby giving insight into the human body [1].

The routine formalin preserved wet organs have their own drawbacks like irritating odour and bleached colourless parts not giving a naturalistic idea. They are difficult to maintain for a prolonged period. Also the luminal architecture, dimensions and branching patterns are difficult to imagine in a dissected specimen. Keeping the above points in mind newer areas have been explored to eliminate the drawbacks. One such technique having promising solutions for most of the problems is Plastination. Plastination is defined as a technique which uses polymers to permit the preservation of bodies, body parts, Anatomical specimens and surgical specimens in a physical state approaching that of the living condition, keeping it fulsome, lifelike, indefinitely antiseptic without any surface morphological modification [2]. In this technique the water and fat in tissues are replaced by certain Plastics, yielding specimens that can be touched, do not smell or decay and can retain most of the properties of the original sample. Thus Plastination is a technique of preparing dry, coloured, non-toxic, durable, odourless and natural looking specimens.

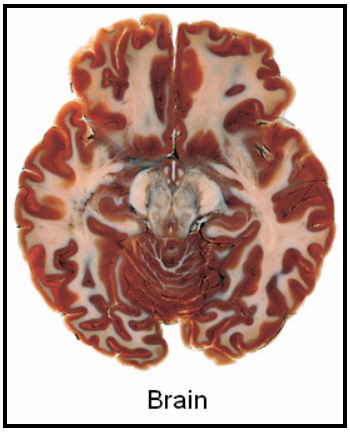
The scientific value of using Plastinated bodies and organs in a teaching environment like Anatomical courses at Medical Schools is hard to dispute. The specimens whether bodies or organs, produced by this method may be handled by students for easier examination. The specimens can be handled and examined from all angles and comparisons made, for example organs in their normal and Pathological state may be examined side by side to illustrate disease process such as placing lungs from a healthy individual, a lung cancer patient and a patient suffering from asbestosis side by side for comparision [2-3]. Apart from adequate space, Ventilation, Vigilance and man power, the plastination process requires deep freezers, vaccum chambers with pump, gas curing chambers, air tight containers and other materials such as PVC pipes, glass rods, glass sheets, clamps etc.

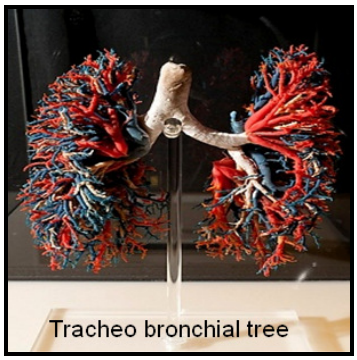
Chemicals required are Curable polymers (such as Silicone, Polyester, Epoxy, Polypropylene, Cyanoacrylates, Araldite), Dehydrating agents (Acetone or Ethanol) and Hardners (such as S3,gas cure S6).Many of these polymers, Hardners and Curing agents are patented by Biodur company and have to be imported. At some places use of indigenous polymers such as araldite has been successfully experimented [4]. The process of plastination involves replacing water and

lipids in biological tissues by curable polymers which are subsequently hardened. The S10 technique is the standard technique in plastination which results in opaque, more or less flexible and natural looking specimens. There are 4 steps in the standard process of plastination:

The first step is Fixation of the Specimen to prevent autolysis of the tissue and it is done in 10% formalin. Hollow organs like heart are dilated during fixation. The Fixed tissue is then Dehydrated by immersing the specimens in Ethanol or acetone bath. Acetone is preferred as Ethanol can cause shrinkage of tissues. The next and most important step is Forced Impregnation in an air tight chamber fitted with a vaccum pump whereby the intermediary solvent is replaced by a Curable Polymer such as silicone rubber (S10), PEM27, Polyester or Epoxy resin. Curing (hardening) is the last step in the process. The specimen is cured with gas, heat or UV light [4]. A specimen can be anything from full human body to a small piece of an animal organ and they are now known as "plastins" or "plastinates" [5-6].

Fig-1: Showing plastinated specimens of horizontal section of Brain, Tracheo bronchial tree and the Vasculature of Heart





There are 3 types of plastinations:

i) Whole body/Organ Plastination: When whole organ or body of an animal is to be plastinated Silicon (S10) and Polypropylene resins can be used. Total structure and relationship of an organ/body are preserved.
ii) Luminal cast Plastination: It is done for hollow organs like Lungs, Stomach, Intestines, Ventricles of Brain, Vascular pattern of Heart and Kidneys.
iii) Sheet Plastination: It involves making of thin, transparent or thick, opaque sections of body or an organ. These sheets are portable and display cross sectional Anatomy comparable to CT or MRI scan sections.

The Plastinated specimens have numerous advantages. They are easy to handle, can be stored in plastic bags and do not require any maintainance. They are similar to the original resection specimens minus the putrid odour. They are non-toxic, non-infectious and do not exude fumes or fluids. By sheet plastination, thin slices of organs, extremities, brain or even whole in situ sections can be done. Sections may vary in thickness from 2mm to 6mm. Sheet plastination has proven to be a vital tool in the enhancement and clarification of Anatomical concepts and relationship [7].

But there are also some limitations to the use of plastination. Process is technique sensitive and time consuming and also it requires trained manpower. It is expensive and many of the polymers need to be imported. It requires a lot of post curing work such as trimming, polishing, colouring and mounting to achieve a good display specimen. The

emotional and tactile experience provided by a wet cadaver is not provide by the plastinates [1, 8].

The plastinated specimens have a wide range of uses. Autopsy or surgical tissue samples are used for teaching purpose. Exhumied mummies, rare animals or archeological materials can be used for display in museums. Preparation of surgically removed facial organs like nose or ear for use as the patients own prosthetic replacement. The plastinated specimens are excellent for teaching Gross Anatomy, Neuroanatomy etc. Silicon casts of ventricular system of brain and trachebronchial tree can be utilized for teaching. They can be used as documentary evidence in Forensic medicine and also as patient educative tool to explain a Pathology or anamoly that the patient is suffering from [4, 2].

More recently in the West, the plastinated specimens were shown to the public arena through an exhibition termed 'Anatomical Art' where normal and Pathological plastinated specimens were displayed. However this exhibition raised an ethical debate about display of human specimens in this fashion. Only educational display is thought to be logical while use of plastinated specimens for financial gain are being questioned. Churches and religious groups protest that whole body plastinates are against the laws of nature and disrespect death. A paradigm shift is required for Anatomists and Forensic experts to contribute to this ethical debate not only as custodians of the dead but also protectors of the living [4]. Plastinated specimens are excellent alternative to formalin fixed specimens. They will bring tridimensionality to teaching in form of clean, touchable, authentic, non-smelly, non-toxic, non biohazardous specimens students. Considering the difficulties in obtaining human cadavers for teaching Anatomy, Plastination serves as an excellent way of obtaining more durable specimens.

References

1. Singh O, Mishra BK, Pandit S et al. Plastination: A promising method for preserving biological specimens: A review article. *International Journal of Scientific and research publication.* 2013; 3(6): 279-281
2. Prasad G, Karkera B, Pandit S. et al. Preservation of tissues by Plastination. *International Journal of Advanced health Sciences.* 2015; 1(11):27-31.
3. Strudges IC. Plastination-Science or Art? *http://en.wikipedia.org/wiki/plastination.* Accessed on 25/8/2016
4. Dhanwate A, Gaikwad M. Plastination-A boon to Medical teaching and research. *IJSR,* 2015; 4(5):1550-1553
5. Pashaei S. A brief review on the history, methods and application of plastination. *Int J Morphol* 2010; 28(4):1075-1079.
6. Von Hagens. Heidelberg Plastination folder Collection of all technical leaflets for Plastination. 2nd Edn. *Heidelberg Anatomische Institute, University Heidelberg,* 1986; (quoted by Dhanwate et al)
7. Mahajan A, Agarwal S, Tiwari S et al. Plastination: An innovative method of preservation of dead body for teaching and learning Anatomy. *MAMC J Med Sci* 2016; 2:38-42.
8. Ravi SB, Bhat VM. Plastination- A novel innovative teaching adjunct in Oral Pathology. *J.Oral Maxillo fac. Pathology* 2011; 15:133-137.

*About the author: Dr. Ashwini Jadhav is an Associate Professor in Anatomy at Dr. Vaishampayan Memorial Government Medical College, Opp. District Court, Solapur-413003 Maharashtra, India. She can be accessible by E-mail: ashwinihar2011@gmail.com