Journal of Advanced Clinical & Research Insights (2018), 1, 72–74

REVIEW ARTICLE

Plastination: Through ages

G. J. Renukaradhya[1], Shilpa V. S.[1], Roopa S. Rao[2]

[1]Department of Veterinary Gynaecology, Hebbal, Bengaluru, Karnataka, India, [2]Department of Oral Pathology, Faculty of Dental Sciences, M. S. Ramaiah University of Applied Sciences, Bengaluru, Karnataka, India

Key words:
Plastination, preserving biological tissue, synthetic polymers.

Correspondence:
G. J. Renukaradhya, Department of Veterinary Gynaecology, Hebbal, Bengaluru, Karnataka, India. Phone: +91-9845618798.
Email: dr_renu70@yahoo.co.in

Received 11 April 2018;
Accepted 26 May 2018

doi: 10.15713/ins.jcri.215

Abstract

Plastination, the technique of preserving the biological tissue or whole body in its life-like state for long term, was developed in 1977 by Gunther Von Hagen. The idea was to utilize the available cadavers or samples in the best possible way to provide students of science with hands-on training into the wonders of life. The preserved tissue and body of humans and animals were also exhibited in galleries to educate the people on the workings of body tissues and organs. Even though, in early ages, the practise was viewed with serious ethical issues, the wonders of human body stated to fascinate humans and people stated donating their bodies to be platinized after their death and to be used for educational purposes. This article discusses on the basic principles and techniques of plastination and how plastination has evolved along with science. It discusses on the different synthetic polymers used as the impregnation media and the different procedures that have been developed from the basic technique. The idea is to create a dry and easy to work with specimen of a biological tissue that can do justice to the intricate and mesmerizing structure of a living tissue.

Introduction

Created and named by Professor Gunther Von Hagen, a German physicist and anatomist, in 1977, plastination was a revolutionary process in long-term preservation of tissues. The term plastination itself has its origin from a Greek word "plassein" meaning "to shape or to form," and this technique can be used to preserve biological tissues or whole human body in its original form. Plastination preserves tissues or whole body in a dry and odorless form which is easy to handle and store for years. It overtook the traditional formalin preservation techniques due to its numerous advantages, and over the years, the process has evolved. The techniques and the substances used for plastination have also changed over time and are discussed in this article.

Origin of Plastination

Since the beginning of the study of anatomy, the dissection of a dead human body has been viewed with prejudice and serious ethical issues. This has demanded the anatomists of the early ages to resort to study in cadavers of murders or homeless people whose body was abandoned. After ages of revolution and scientific advancement, even today, the study of a dead body holds ethical issues and the proportion of people who donate their bodies for organ donations or scientific studies is still low. The idea still remains that the dead body should be cremated or buried according to the respective religious beliefs for the peace of soul. Hence, over times, the scientists have resorted to preserve the available cadavers or body tissues in the best possible ways to aid the science students to get their hands-on training. Around the same time, plastination was discovered, scientists were already using formalin preserved samples, and some others have resorted to extensive drawings, depictions, and descriptions of live body tissues after dissection. Andreas Vesalius and Leonardo da Vinci, two among the great artists of the time, created extensive artworks on the working of the human body. Inspired by the work of these fascinating artists, Hagen has mentioned in his works that illustrations or models may be able to convey the beauty of individual body structures but the truth lies in originals.[1] The words still hold true in the 21st century where advanced imaging techniques can give us a 3D illustrations of the miracles of the biological tissue, but unless a science student feels the originals, a part of the truth will always remain hidden. Moreover, for this reason, the technique was born and the plastinates are identical in condition to the tissue before preservation even to a microscopic level.

Principle

Plastination, the technique aims at preserving any biological tissue in its life-like form. The principle behind the technique is that once we remove all body fluids like water and the fat

content to replace them with inert materials, the durability of the tissue increases exponentially. The product will be life-like, dry, odorless, non-toxic, durable, and easy to handle. This can ease the use of tissue for scientific study or as exhibits. The material used as inert matter for plastination needs to fall under certain characteristics to be used as impregnation polymer. The polymer used should be easy to handle with low viscosity in uncured state, and the base and the catalyst activator mixture must have a long working time to allow maximum impregnation into the tissues. The substance must be able to undergo hardening or curing in the tissues, and after curing, the polymer should become firm and rubber-like to stimulate natural form (Prasad *et al.,* 2015). Based on the substance used, the type of plastination changes. The use of silicon gives resilient flexible specimen, whereas thick body slices can be impregnated with polymerizing emulsions which give more rigid specimens. Use of epoxy resins gives a transparent specimen, while a polyester resin gives opaque brain slices.

Techniques

Plastination basically includes the steps of fixation, dehydration, forced impregnation, and hardening and curing. The materials used and the techniques are being modified regularly. Fixation, the first step is aimed at preventing or halting decomposition by keeping the embalmed body in formaldehyde solution. The next step dehydration is done by placing the tissue in acetone. On freezing, the acetone replaces the water within the cells. The sample then needs to be immersed in liquid polymer, namely, silicon rubber, epoxy resin, or polyester. The acetone is made to vaporize with the help of vacuum drawing the liquid polymer into the cells causing the forced impregnation. The plastic thus impregnated is then hardened with gas, heat, or ultraviolet (UV) light and is called curing of the specimen. Gas is used as curing agent mostly when the agent is silicone resin. The end specimen is called plastins or plastinates.[1] Some other techniques are core-tech room temperature, epoxy E12 procedure, and polyester P35 (P40) procedure.

Raoof[2] examined the efficacy of room temperature plastination technique in studying the length of prenatal spinal cord to determine the age of human fetus. This was done using acetone at room temperature for dehydration and COR-TECH PR-10 silicon polymer mixed with a crosslinker as impregnation media and cured at moist room temperature. Gao *et al.*[3] studied on technique of sheet plastination where a cape dolphin was cut into 348 transversal sheets fixed using 10% formaldehyde and bleached with 5% dioxogen. The specimens were impregnated with Hoffen polyester and cured using UV light. The sheets were then reassembled for display. Steinke *et al.*[4] described about lightweight plastination to reduce the difficulty of carrying around heavy plasticized specimen. This was achieved using a combination of silicon and xylene as impregnation substance.

Advantages and disadvantages

The advantage associated with plastination is that the plastinates can be stored in simple plastic bags and requires little storage and no maintenance. The specimens can be easily carried around, and the tissues are superior to other techniques such as the use of formalin or other techniques. Plastination can be implemented in specific parts such as bone and dental areas (to study dental decay and other surgical procedures), for comparative study of animal and human specimens, models for equine study, and preservation of wet fragile tissues like intracerebral hematoma. Insect larvae within the soft tissue of putrid specimens can also be preserved.

The major disadvantages associated with plastination include shrinkage and change of color. The process is specific and time-consuming with the need of trained personnel. The procedure is expensive and requires specific laboratory equipment. Even after plastination, the specimen needed to be trimmed, polished, colored, and mounted to give life-like feel (Prasad *et al.,* 2015). Sometimes, the procedure can cause an alteration in shape of tissue or surface and damage the vessels or nerves in the sample.[5-7] These could be due to variations in the temperature used in reactions or when they use old samples preserved in formalin. It can also cause color changes when badly fixed samples are used.[8] Another disadvantage could be the absence of tactile and emotional experience to an anatomy student that could be achieved in wet cadavers (Prasad *et al.,* 2015).

Other techniques of preservation

Mummification, an ancient method developed in Egypt to preserve the remains of royalty over ages, is a technique that dehydrates the body and wraps it in linens. The body was dehydrated in sun and then mummified. The major disadvantage with this technique was that the integrity of the tissue is lost and the tissues undergo shrinkage and loss of details.

Formalin use, introduced in 1896, can be considered the most traditional method of preserving specimens. In this process, the specimens are usually saturated with formalin and kept in open or closed glass bottles. These specimens are very difficult to work with due to strong unpleasant odor and need for a lot of maintenance as the specimens can rapidly deteriorate or dry out. Formalin also poses health hazards like irritation to nose and eyes. Further, most of the time, formalin bleaches the tissues.

This was followed by embalming techniques with colored solutions where the body fluids are replaced by colored solutions and further advanced to use paraffin impregnation introduced in 1925.

In the 21st century, the preservation techniques are so advanced to the level of cryopreservation; here, the body fluids are replaced by cryoprotectants which protect the cells of the body from cryo-injury during the storage process. This technique aims at preserving a dead body or tissue as long as the technology can catch up and aid in reviving the dead and correcting the ailment that caused the death in the first place. The disadvantage with this technique is that the body so preserved is not intended for academic anatomy studies and taking the sample out of cryocan for studies can be detrimental to the specimen.

Conclusion

Plastination is so far an almost ideal technique to preserve biological tissues for long term and to aid in the study of anatomy and topographical anatomy and to be used as specimens to practice surgical techniques. The specimens are easy to handle and reduce the number of cadavers needed for the academic purpose of teaching, research, and molecular or cellular studies. These are also ideal specimens for museum and exhibitions. The specimens are almost lifelike even to the point of retaining the integrity of blood vessels in their dilated confirmation.

References

1. Singh O, Mishra BK, Pandit S, Maheshwari TP, Hasan S. Plastination: A promising method for preserving biological specimens: A review article. Int J Sci Res Publ 2013;3:2250-3153.
2. Raoof A. Using a room-temperature plastination technique in assessing prenatal changes in the human spinal cord. J Int Soc Plastination 2001;16:5-8.
3. Gao H, Liu J, Yu S, Sui H. A new polyester technique for sheet plastination. J Int Soc. Plastination 2006;21:7-10.
4. Steinke H, Rabi S, Saito T, Sawutti A, Miyaki T, Itoh M, *et al*. Light weight plastination. J Ann Anat 2008;190:428-31.
5. Latorre RM, Reed RB, Gil F, Azla MD, Martinez-Gomariz F, Henry RW. Epoxy impregnation without hardener: To decrease yellowing, to delay casting, andto aid bubble removal. J Int Soc Plastination 2002;17:17-22.
6. Ripani M, Bassi A, Perracchio L, Perez M, Bocicia ML, Maranozzi G. Monitoring and enhancement of fixation, dehydration, forced impregnation and cure in the standard S-10 technique. J Int Soc Plastination 1994;8:3-5.
7. Schwab K, von Hagens G. Freeze substitution of macroscopic specimens for plastination. Acta Anat 1981;111:139-40.
8. Miklošova M, Mikloš V. Plastination with silicone method S10–monitoring and analysis, causes of failure. Biomed Papers 2004;148:237-8.

How to cite this article: Renukaradhya GJ, Shilpa VS, Rao RS. Plastination: Through ages. J Adv Clin Res Insights 2018; 5: 72-74