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Comparative Study between Various Reagents of Plastination in Making Museum Specimen

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ABSTRACT

Background: Plastination uses polymer as an agent which preserves the specimen in a near-natural state. This technique has advantages over the traditional method of body part preservation and handling of the specimen. But the main drawback remains its cost and availability of the reagents. Till date, this technique of specimen preservation has not been used by any surgeon. Hence we plan to use this technique of plastination for the preservation of museum specimen. We also plan to compare various reagents used for the same as commercially available resins and touchwood primer paint.

Objectives: Primary objective: to study the efficiency of various reagents of plastination for the preservation of the surgical specimen.

Methods: This is a prospective interventional randomized study over 1 year period. Study population: 5 specimens in each group of reagent. All the specimens in both groups will be subjected to the same process of Plastination, specimen selection, dehydration and defatting, vacuum impregnation, positioning, curing, specimen analysis over 6 months.

Results: The Plastination specimen of Touchwood reagent will be compared with the standard Plastination reagent specimen in terms of durability, handling, clarity of specimen and cost-effectivity.

Conclusions: The specimen should be comparable to the specimen of epoxy resin reagent in terms of durability, clarity and ease of handling.

Key Words: Plastination, Surgery museum specimen, Resin, Touchwood paint

INTRODUCTION

The concept of visualizing any specimen or body part virtually and in real-world has got different impacts on medical students. Anatomist uses human bodies as an educational tool to teach medical graduates¹ while the diseased organs are taught in surgery with the help of mounted specimens. Various studies have proven that human bodies have some definitive characteristics and hence there is no alternative to it as an educational tool. Recently there has been a lot of discussion amongst the anatomists against the utility of dissection as a useful method.² Dissection is seen as an old fashioned way of virtualization. On the other side, some clinicians prefer using dissection as a tool to enhance the knowledge about human anatomy in a better way, but they feel that there is need for re-enhancing anatomical education by dissection.

The proper and efficient demonstration of the human organ is it normal or diseased needs a properly preserved and mounted specimen. Preservation is said to be proper when the body remains unharmed and free from decomposition. While dealing with this issue of body or body part preservation some definitions have to be clear. Merriam-Webster's dictionary³ defines

Preservation: an action to keep something 'safe from harm, destruction or decomposition

Conservation: the process of 'a careful preservation and protection of something'

Embalmmment: the 'treatment (of a dead body) – with special chemicals –to protect from decay.'⁴

There are many solutions in use for the technique of embalming available with formaldehyde as the most common

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in use. The use of methanol or formaldehyde is not considered as the user as well as environmentally friendly. The most dreadful disadvantage of the use of formaldehyde is its strong smell and generated irritant fumes. These drawbacks of formaldehyde arouse the need for a newer technique of specimen preservation i.e. Plastination which uses polymer as the agent. It helps to preserve the specimen in a near-natural state. In this technique, the lipids and the water present in the specimen are replaced with synthetic components like polyester or silicon. When this material is dried up a natural-looking and long-standing specimen is ready.⁵ The important advantage of this technique over traditional technique is that the anatomical details and handling of bodies or specimen is easy.^{6,7}

Pioneer of Plastination as Gunther Von Hagens. He introduced this technique of Plastination in 1977 in the Department of Anatomy at the University of Heidelberg with patent received between 1978 and 1982. The most commonly used agents are

- Silicon polymer (S10) for the preservation of a realistic whole body or parts of organs
- Epoxy polymer (E12) for transparent body or tissue slicing
- Polyester polymer (P40) for encephalic sections⁸

The main drawback is the cost of all the available reagents. Hence there is a need to introduce a cost-effective reagent to replace these available reagents. With this aim, the topic is taken to evaluate the efficacy of an easily available and cost-effective reagent for Plastination of specimen.

All the available reagents of Plastination are too costly and not readily available for Indian researchers easily. Hence there is a need to evaluate various readily available reagents with almost similar composition as a replacement to these costly reagents.

MATERIALS AND METHODS

Study Design: a prospective interventional randomized study

Setting: Specimen extracted from the surgeries conducted at AVBRH, Sawangi (Meghe), Wardha

Participants: 5 surgical specimens in each group of reagent

Specimen selection:

The specimen will be cleaned under tap water to get rid of formalin and cross section will be taken without disturbing the anatomical details. The arteries and vein can be injected with red and blue latex respectively.^{9,10}

Dehydration and defatting:

The selected specimen will be kept completely immersed in acetone for dehydration in a – 24°C 90 - 100 % acetone bath to remove the water in an airtight container. The acetone bath will be repeated till the acetone purity will be reached 95 % equilibrium. By his process, we will get the water free specimen.

Then the specimen will be kept in 99 to 100 % acetone bath at room temperature for defatting as fats do not undergo proper Plastination. These 99 to 100 % acetone bath will be repeated until the acetone purity will be above 98 % equilibrium where we will have clear acetone and fat-free specimen. The process of dehydration will vary from specimen to specimen depending their permeability, thickness and amount of water and fat content.¹¹

Forced impregnation of Epoxy

This is the crucial step of Plastination where epoxy polymer will replace the acetone from tissue spaces initially occupied by the water and fats. The extraction of acetone and filling of tissue by epoxy will be simultaneously accomplished by the vacuum. This will be carried out by placing the specimen in a container filled with epoxy, placed in a vacuum chamber. This process will last for a few weeks depending upon the type of tissue used.¹²

Positioning

The impregnated tissue will be properly aligned to maintain the anatomical structural detail of various tissue parts. During above all various process, delicate tissue part may change their placement.

Curing

This process will involve the application of the curing agent which catalyzes the reaction between the epoxy and its cross-linker resulting in hardening of the specimen. The catalyst used in the process will be Xylene. This will be aided by flowing air.¹³

Qualitative variables: all these specimens will be evaluated for

- a. Durability
- b. Ease of handling
- c. Clarity of specimen
- d. Cost effectivity

EXPECTED OUTCOMES/ RESULTS

Touchwood reagent of Plastination is efficiently comparable to the epoxy resin reagent of Plastination for the preservation of various surgical specimen for a longer duration. Low-cost

reagents of Plastination can also be a good replacement for high-cost Epoxy Resins as Plastination Reagent. The plastinated specimen in both groups must be comparable because of

- a. Durability
- b. Ease of handling
- c. Clarity of specimen
- d. Cost effectivity

DISCUSSION

The method of plastination is new to our researchers hence there is a wide range of things that can be done in this field. Moreover need of the time is to have a good, durable, easily available and cost-efficient reagent for this process. Hence this study to evaluate the efficacy of newly introduced and readily available reagent as compared to the costly but in vogue Reagent. The study should be followed for a longer duration to assess the durability and usefulness of these specimens in long run.

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