# Plastinated Specimens - as Teaching AIDS

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**ABSTRACT**

Plastination is a specialised technique used for soft tissue preservation. It was developed by Gunther von Hagens in 1977. Plastinated specimens presents advantages over other methods of preservation because they exhibit precise anatomical features. They are clean, dry and easy to handle. Plastinated specimens are developed by using acid curing polymer technique. Plastination is a very easy method for preservation of soft parts in their dried and original form for a very long time. Plastinated specimens serves as a great aid for understanding anatomy of different organs in their original form with any disturbance of smell.

**Keywords:** Plastic resins, Xylene, Acetone, Melamine, Plastinated specimens

## INTRODUCTION

Plastination is a good method for preservation of non-toxic anatomical specimens. These can be used for long-term educational purposes. The basic principle of plastination is that a plastic polymer replaces the biological fluid within a given specimen. Dr. Gunther von Hagens first invented this method in the 1970s.[1] Body Worlds exhibit was developed by Dr. von Hagens, which has been displayed in museums around the world. We utilized plastination to preserve human body specimens for educational purposes. These plastinated specimens are an excellent tool for teaching anatomy and pathology, for medical education. Specimens produced by plastination are dry, odorless, rather durable and usually free from encasing material.

### Types of Plastination

On the basis of size, shape and nature of tissue, there are three types of plastination viz. Whole body/organ plastnation, Luminal cast plastination and Sheet plastination.

**Whole organ or a body Plastination-** in this method, Silicon (S10) and polypropylene resins are used. Using this technique, whole of the structure or organ, and its relationships can be preserved.

**Luminal cast plastination-** is done for hollow organs like lungs, stomach, intestine, ventricles of brain, vascular pattern of heart and kidneys. Specimens are dilated/inflated during fixation, dehydration and curing. Beautiful and precise bronchial pattern can be seen by this technique.

**Sheet plastination -** In this method**,** thin transparent or thick opaque sections of body or an organ are preserved. These sheets are portable and shows cross sectional anatomy of organs equivalent to CT or MRI scan sections. Sheets can be taken in various planes. Thin sections (1-2mm) of organs are similar to routine histology slides. Polymers such as epoxy (E12), polyester (P35) or polypropylene (araldite) resins are used for making sheet plastinates.

### Principles of Plastination

The underlying principle of plastination is that water and lipids are removed from the tissues and they are replaced by a plastic (curable polymer). In Plastination different types of polymers are used, the most commonly are epoxy, silicone rubber, and polyester. For obtaining the best plastinated specimens, the polymer used, must have the following desirable properties:

1. It must have lowest possible viscosity in uncured state.
2. Its refractive index of the polymer should be different from that of tissue (otherwise a transparent specimen would be obtained).
3. Resin activator mixture (base and catalyst) should have a long action time or a relatively long liquid phase life so that, it allow time for impregnation of the tissues.
4. Curing should not be inhibited by the tissue.
5. Mechanical properties of the polymer should be appropriate when cured, that is, it should be rubber like to simulate a natural state, or firm.
6. It should be affordable.

Considering these requirements, the polymer that has enjoyed widest acceptance in the preparation of specimens for teaching is silicone rubber.

## MATERIAL AND METHODS

**Consumables –** These include adequate space, ventilation, vigilance and manpower. The plastination requires consumables or chemicals like- Formalin, Acetone, Xylene, Melamine, deep freezers, airtight containers, Glass jars with lids and other materials as glass rods, sheets, clamps etc., and paint brush.

The process of plastination comprise of subsequent steps:

Fixation**,**
Dehydration,
Clearing,
Impregnation,
Hardening

### Fixation

Specimens whose plastination is to be done are fixed in 10% formalin (by arterial injection) for several days; this stabilizes the tissues and prevents autolysis. The fixed specimens were thoroughly rinsed in clean water to remove excessive fixative.

### Dehydration

In this step, Formalin fixed specimens were dehydrated in acetone. The specimens were passed
through three changes of acetone. This can be done for a period of 3 weeks (biological specimens were re- immersed

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in undiluted solution of acetone for 3changes each of 7 days); thus, the tissue water is slowly replaced by the acetone. The volume of acetone used for dehydration was about 10 times the volume of the specimens. Left over acetone can be reused during the initial stages of dehydration for another specimens, till its specific gravity reduced to its half while pure acetone was used for the last change.

**Degreasing**

The specimens after dehydration were placed in increasing pure baths of degreasing agent i.e., Xylene for clearing for period of 21 days or 3 weeks. It comprised of 3 changes each for 7 days. Xylene acts as the volatile intermediary with the acid curing polymer and also a degreasing agent for lipid rich specimens.

Impregnation of Polymer

This can be performed at room temperature. Biological specimens were placed in the mixture of xylene and acid curing polymer, melamyne with hardener in 1:1 ratio for 10 days.

**Hardening**

Biological specimens were then taken out from impregnation mixture, and then, painted with melamyne and dried at room temperature.

Thereafter the specimens were once again painted with melamyne. Plastinates thus procured can be mounted on stand for demonstration.

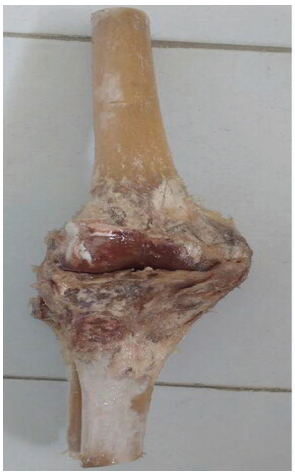
Plastinates serves as a better option for demonstration of original biological specimens than man-made three-dimensional models, simply because they have developed from the natural, individual growth of human bodies—models, on the other hand, have at some point had to be consciously designed. Sometimes plastinates are even far more better than untreated anatomical specimens. Following plastinated specimens were obtained on following the steps for plastination:- - Plastinated Uterus, Kidney, Elbow Joint, Knee Joint (Figure-1-4).

## DISCUSSION

The plastination technique is an innovative procedure- for the precise visualization of the topographical (gross) anatomy. M.C. Sora and P. Cook stated that Biodur E- 12 plastination method allows production of highly transparent sectional preparations of high visual clarity.[15] Plastination makes it possible to preserve individual tissues and organs that have been removed from the body of the deceased as well as the entire body itself. Henry RW in 1987 used Silicon polymer for preparation of plastinates for histochemical studies.[7]

Steinke H et.al. in 2008, developed light-weight plastinated specimens using xylene along with silicone and in the final step, substitute xylene with air. The finished plastinated specimens were light-weight, dry, odourless and robust. This method requires less use of resin thus making the plastination technique more cost-effective.[17]

In 2014, Mustafa F. Sargon, et.al, used Epoxy plastination method, which preserves 2-5 mm slices of biological tissues by using epoxy resins. In this technique, all tissue fluid and a significant amount of fatty tissue was replaced with a curable epoxy resin mixture. Epoxy plastination method provides very precise semi-transparent sectional specimens and in these preparations;gross anatomical structures can be examined with the naked eyes.[20]



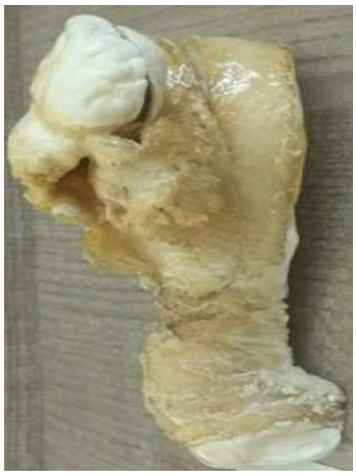


**Figure-1:** Plastinated knee joint; **Figure-2:** Plastinated uterus

**Figure-3:** Plastinated kidney; **Figure-4:** Plastinated elbow joint

Plastination is simple in theory: In order to make a specimen permanent, decomposition must be stopped. And this is done by removing water and fats from the tissue and replacing these with polymers, the Plastination process deprives bacteria of what they need to survive. Raof A,et. al. used silicone plastination technique for preparation of plastinates and found that PR 10/1 specimens are durable.[16]

At present, plastination has established itself as an indispensable contributor for teaching gross anatomy to clinical anatomists (Jones, 2002; Reidenberg and Laitman, 2002). Teachers have agreed that plastinated human specimens are superior specimens in relation to synthetic models, on account of their ability to reflect anatomical variations. The main aim for using plastinates is to reduce the formalin concentration in the fixative solution down to 3%. S.B. Ravi and V.M. Bhatt, 2011 find its application in preparation of oral pathology slides using silicon polymers.[18]

In 2013, Venkatesh G Kamath used Luminal plastination method for preparation of luminal cast of the sheep lung showing its tracheobronchial pattern.[19]

At present time plastination products are increasingly used as a training tool as well as a research mean thus, appreciated throughout medical schools. The increasing demand of

plastination is because of its ability to preserve delicate structures and their interconnections, so that they can be traced microscopically.

## CONCLUSION

Plastination would have a great future in all fields of training, research and also public culture and instruction throughout the world. Since, it is a new, fast and hazardless technique it will be soon be available to many departments of anatomy. Also, the plastinates are cheaper in costs and also natural in appearance - this makes the plastination a unique window to the world of anatomy learners. It has been a good replacement for formalin as a preservative and there are no health hazards. The future research should target to develop fast and cost effective techniques of plastination.

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