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Cadaveric study of Plastination over formalin

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Abstract
Introduction: The successful preservation of conventional methods by embalmed cadavers/ corpse's are routinely practiced for educational/research purposes. 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 sciences. So, to overcome the toxic effect of formalin, plastination is used.
Aim and objective: Plastination study formalin preserved specimen to reduce the side effects of formalin. Detailed study with preservation of biological specimen by the help of plastination, as it easy to handling odourless, non-hazardous, stable procedure and provide better platform to study for a longer span of time.
Material and method: A Luminal cast Plastination was prepared by GP silicone sealant was injected into tracheobronchial tree after thoroughly cleaning the lungs with saline. After the sealant solidified the surrounding lung tissue was destroyed by boiling. And a Sheet Plastination was prepared by cut thin slice brain and mounts by resin used for making thin transparent section.
Conclusion: A prolonged exposure to high concentration of formalin can not only discolour the specimens, but it also makes them toxic, hazardous, fragile and unpleasant to use whereas plastinated organ to reduce side effects of formalin, produce dry, odourless, durable, life-like, maintenance- free, and non-hazardous specimens. Plastination has a great future in all fields of teaching and research.

Keywords: Cadaveric study, Plastination, conventional methods

Introduction
Preservation of cadaver play important role in medical education, scientific research or tissue transplantation [15]. 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 corpse's. The successful preservation of conventional methods by embalmed cadavers/ 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 [4]. 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 sciences [2]. When we visit a museum, we can see specimens of abnormal growth of human beings and animals. Though the various features can be appreciated, the specimens appear bleached and a pungent odour emanates if the liquid surrounding the specimen oozes out. we cannot touch the specimen as the chemical in which the specimen is preserved that is formalin; it has so many health hazards. The main drawbacks of fixation and preservation of tissue in formalin are that they suffer from easy breakage when handled (brittle), and transportation is a tedious process with problems of spillage. Toxicity of formalin is also a major health concern [8]. Formalin is a colourless and irritative fluid that contains 37% of formaldehyde and is widely used as a preserving agent of biological specimen [12]. Formaldehyde was discovered in 1856 by the British Chemist, August Wilheld Von Hofmann [11]. It is a noxious, flammable gas, extremely soluble in water. Formalin is a colourless (at room temperature) [13]. irritant which gives out pungent formaldehyde vapours and is widely used in the medical field as fungicide, germicide, disinfectant and preservative [7].

The anatomy faculty, students, embalmers and histopathology technicians are continuously exposed to the toxic vapours of formaldehyde. Hence the anatomy dissection laboratory represents a significant emotional challenge to many medical students.

Dr. Gunther Von Hagens began experimenting on a new technique of preservation of specimens. Though a few articles earlier to his study mentioned about plastics, it was Dr. Gunther who experimented voraciously on diffusing various plastic into large specimens, and ultimately succeeded and coined the term "Plastination" in 1977 [10, 14].

Plastination is used in hundreds of laboratories worldwide to help with the teaching and study of the body. Plastination is useful in anatomy as well as serving as models and teaching tools. The plastinated specimens were more flexible, durable and lifelike. The use of plastination allowed the use of many body parts such as muscle, nerves, bones, ligaments and central nervous system to be preserved. This procedure utilize polymers which are forcefully impregnated into the tissues to make them stable and free from deterioration. They can also be handled with ease and are not brittle like the formalin preserved tissues [8]. This method has proved to be the superior method for preservation of gross specimens.

Material and method

The present study has been conducted in department of Anatomy, Dr. S.N. Medical College, and Jodhpur. Preservation of biological specimens was done by method of plastination i.e. Luminal and sheet plastination. We had done without using vacuum chamber.

Fig 1

Luminal Cast Plastination

- Fresh organ is preferred.
- Lumen is cleaned.
- Mucous, blood, secretions etc. will be cleared with repeatedly wash.
- After clearing the excessive amount of water remove.
- Plastination material Silicone sealant inserted with help of silicone gun.
- After that dissected larger easily removable structures and boiling done for half to one hour, so most of the tissues dissolve, leaving the beautiful luminal cast.
- Silicone produces an excellent, soft, flexible cast, showing 3- dimensional orientation of cavity.

Sheet Plastination

This is a wonderful method of preparation of thin-transparent opaque body sections.

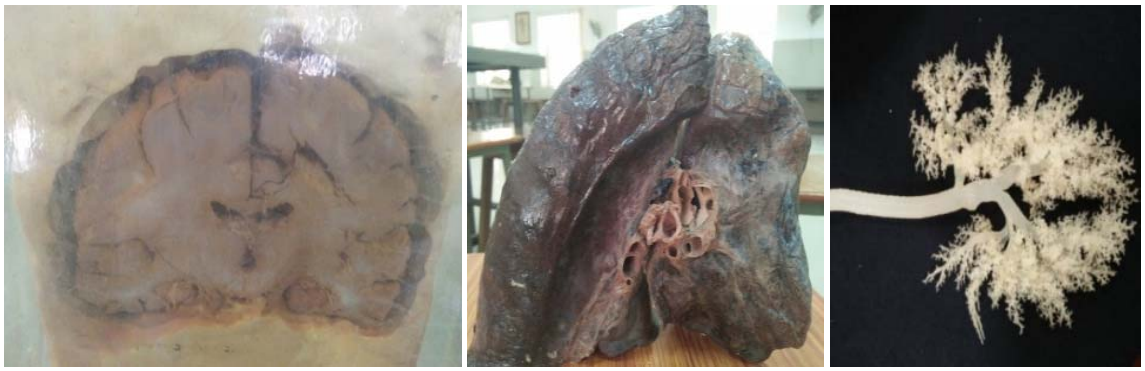
The sheets are totally portable, the whole body being convertible into slices and stored dry.

- A double – glass chamber required.
- A sheet of same sized OHP transparency is kept on the glass sheet.
- A rubber tube with stiff metal wire inside is placed on the OHP sheet clad glass sheet.
- Another glass sheet with OHP sheet covering is the next layer.
- Now clips are put to the bottom and sides.
- Make a leak proof chamber.
- The processed section is placed in the middle of the chamber.
- Resin and accelerator (0.01%) mixture is filled into the chamber.
- Clips are removed; glass sheets are carefully separated from resin sheet; edges are trimmed and polished.

Observation

We were observed Plastinated specimen by using different methods and compared with formalin preserved specimen.

Figures shows: - In this we observed colour, flexibility and handling of Plastinated specimen where as formalin preserved.



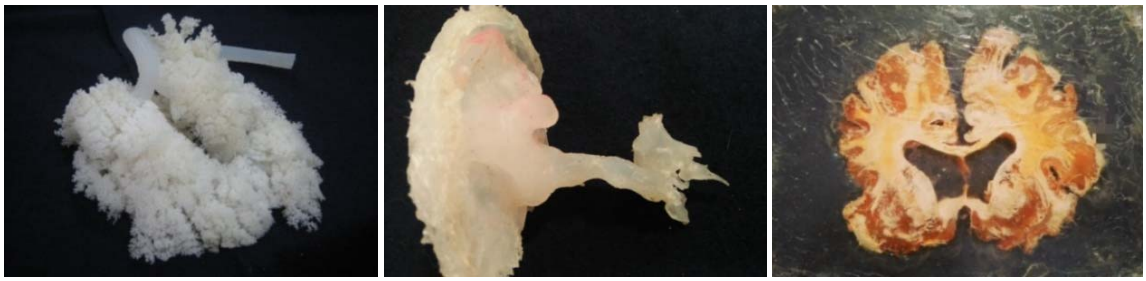


Fig 2: Plastinated Preserved Specimen

Result

The finally Plastinated and old formalin fixed specimens were Compared

Group I Plastinated specimens, as they exhibited a life-like look, as compared to the corresponding Group II old formalin embalmed specimens.

The gross morphological features of the lung and the internal structures were seen.

The responses were recorded as Yes/No (Y/N) as regards to criteria which were under evaluation. A response of Yes was considered as satisfactory.

Graph 1: for formalin preserved and plastinated specimen

A) Colour Y/N: - Did the Specimen Maintain Colour?
B) Flexibility Y/N: - Was the Specimen Flexible?
C) Handling Y/N: - Is it easy to Handle?

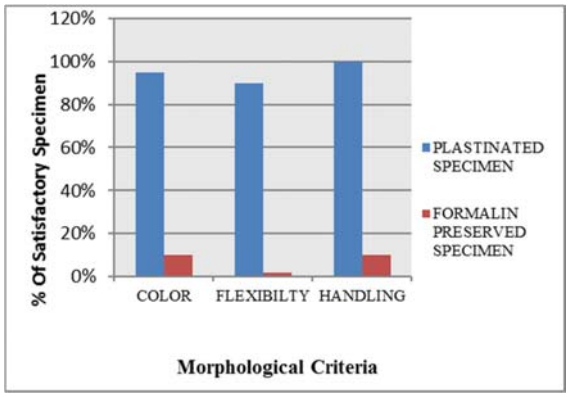
Graph 2: internal structures seen in?

A) Plastination Y/N
B) Formalin Y/N

Graph 3: success rate of plastination over formalin

A) Maintenance Y/N: - Was maintenance Require?
B) Toxic fumes Y/N: - Were a toxic fume Produced?
C) Special Jar Y/N: - Is special Jar Required?
D) Aesthetic Y/N: - Is the Specimen Was Aesthetic?
E) Durability Y/N: - Is the Specimen Durable?
F) Odourless Y/N: - Was the procedure Odourless?
G) Portable Y/N: - Is it Easy to Portable?

There graph and Explanation is given below:-



Graph 1: for formalin preserved and plastinated specimen

Each specimen of both the groups was evaluated on the basis of its morphological criteria:-

1) Colour

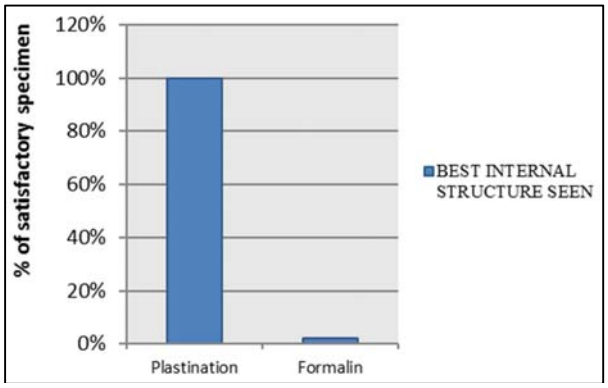
The specimens with a life-like colour were marked as satisfactory, while those with any discolouration were marked as unsatisfactory. All the specimens of group I (Plastination) had good colour preservation except one specimen. On the other hand, only one of the specimens from group II (Formalin) showed a satisfactory colour, as all the other specimens had turned dark.

2) Flexibility

Most of the specimens of group II lost their flexibility, while those of group I remained flexible.

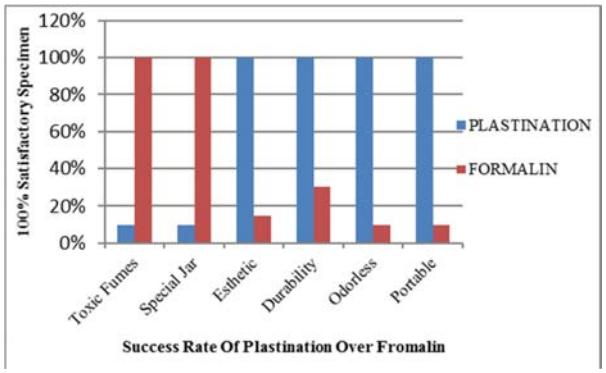
3) Handling

Group I specimen easy to handle while those of group II specimen it cause spillage and leakage.



Graph 2: best internal structures seen in

Each specimen of both the groups was evaluated on the basis internal structure in Group I (Plastination) in which we obtained best internal structures of the specimen, the principle involves filling up of the lumen with material and dissolving the surrounding tissue. A 3-Dimensional structure was visualized while in group II formalin preserved specimen 3- Dimensional structure could not visualize.



Graph 3: success rate of plastination over formalin.

Evaluation of specimen based on their success rate:-

1. **Toxic Fumes**: Toxic effects of formaldehyde exposure can be caused irritation of mucous membrane, contact dermatitis; teratogenicity and carcinogenicity while those of plastinated specimen.

2. **Special Jar**: Group II formalin preserved need a special jar (glass) filled with 10% formalin and glycerine while those of plastinated specimen it can be stored in simple plastic bags, along with appropriate documentation. Generally easier to interpret; therefore students are more interested in examining plastinated specimens than those preserved in formalin jar.

3. **Esthetics**: Plastinated specimen group I is superior to their counterparts in formalin both in terms of aesthetic superiority and in their demonstration of specific features.

4. **Durability**: Group I (Plastinated specimen) can be stored for long duration to maintain the morphological structures while those of formalin.

5. **Odourless**: The Group I Plastinated internal organs are drying odourless, easy to demonstrate the gross morphological details. The plastinated are utilized as teaching aids and anatomical museum models than formalin fumed dripping wet specimens.

6. **Portable**: Plastinated specimen can be easily carried to lecture halls/classrooms and also can be easily passed to each student without gloves, appreciating features which are impossible in jar specimens. Excessive formaldehyde vapour in the working area can be caused by a work environment that facilitates the spillage of formalin, poor condition of cadavers which causes embalming fluid to leak.

Discussion

Anatomy is a fundamental educational science in medical universities. In the study of anatomy the use of gross specimens is mandatory. The decay of this material is an impediment to all morphological studies, teaching and research. Thus the preservation of biological materials become essential for them to be used as educational tool. Their preservation is most commonly achieved by using liquids such as formaldehyde, alcohol and glycerin. A prolonged exposure to high concentrations of formalin can not only discolor the specimens but it also makes them toxic, hazardous, fragile and unpleasant to use. The tissues which are fixed in formalin require periodic wetting to prevent them from drying. Inhaled formaldehyde is proven to cause carcinoma.

In present study we used an alternative approach called "Plastination" to study and teach gross specimens using silicone polymers. The process is simple, inexpensive and can be carried out in any laboratory to produce dry, or odorless, durable, life-like, maintenance-free and non-hazardous specimens. In this study we use formalin preserved specimen and fresh organ for plastination.

Ameko *et al* stated that it is possible to use the modified S10 protocol of to perform room temperature plastination on Whole and Dissected Guinea Pigs with locally available silicone paste and hardener in Ghana.

Lee *et al* stated that the production of a tracheobronchial cast by injecting the trachea with ERTV silicone.

Prasad *et al* explain about the material used and main procedure for plastination transparent body or organ slices produced with epoxy resins. Specimens produced with polymerizing emulsions are as opaque as the silicone specimens but are rigid and to some extent breakable. This technique is used in thick body slices and opaque brain slices impregnated with polyester resin; they allow a unique discrimination between fiber and nuclear areas. Example: P35 of Biodur Company.

Mehra *et al* used a novel method to Plastinate cadaveric hearts. A solution comprising equal parts of Quickfix (wembley laboratories) and amylacetate was used for impregnation. They conclude that this procedure is simple to perform cost effective and is carried out at room temperature (37 C – 40 C).

Chandel *et al* used Melamyne (polymer) and Xylene (intermediary volatile solvent) for plastination. Formalin fixed acetone dehydrated specimens were degreased in xylene and finally impregnated with acid curing polymer melamine with its hardener at room temperature to get dry, durable plastinates.

Conclusion

Plastinated specimens are an excellent alternative to formalin – fixed specimens. The plastinated internal organs are dry odourless easy to demonstrate the gross morphological details and internal structures over the formalin in which high concentrations of formalin can not only discolour the specimens, but it also makes them toxic, hazardous, fragile and unpleasant to use. The principle behind plastination is that the water and fat of the tissues are replaced by certain plastics yielding specimens that not only retain most properties of the original sample but also do not smell or decay.

Plastination has a great future in all fields of teaching and research. Natural appearance of the specimens makes the plastination a boon for anatomy learners. It is a good replacement for formalin as a preservative and there are no health hazards. Plastination has a great future in all fields of teaching and research.

Plastinated specimens can serve as an excellent educational tool for the undergraduate and postgraduate students of anatomy, radiology and orthopaedics as they are dry, odourless ananon toxic with a good structural preservation and a higher instructional value.

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