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PLASTINATION: A MIRACLE IN THE PRESERVATION OF BIOLOGICAL SPECIMEN

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ABSTRACT

Plastination is a novel technique to preserve the body and its parts. It preserves the tissue permanently in a life- like state. In this method, water and fat of the biological specimen is replaced by polymers. Unlike formalin, this method of preservation is without any health hazards. In this study, plastination was done in few cadaveric organs like heart, lungs, brain, kidneys etc. The plastinated organs were displayed to medicals students and faculties. Their feedback, suggestation and use of plastination technique have been discussed in detail. Plastination is an important contribution in the development of a model and teaching aids for better understanding of anatomy.

KEYWORDS: Plastination, anatomy, specimen.

INTRODUCTION

Plastination is a technique of preservation of body or its parts with a great variety in its processes and development which is originally introduced to the medical world by Dr. Gunther von Hagens in 1977. In these processes, water and lipids of biological tissues are replaced by curable polymers mostly silicone, epoxy and polyester. The polymers later harden and finally result in natural looking; dry, odorless and durable specimens.[1] Among these polymers, polyester resin has been used for the production of opaque body slices. Epoxy resins are used for transparent body or organ slices.[2] Many applications for plastinated tissues, organs and sections of bodies, prepared by the standard techniques of plastination, have been cited. Also they have been recognized as perfect tools for direct or indirect instructional purposes like teaching students.[3] In recent years there is a growing tendency toward plastinated products. This growing tendency is reflected in articles which highlight the primary role and importance of the plastinated specimens as important educational, research and cultural tools in the medical world, although there are still arguments on the usefulness of these tools among anatomists.[4] At present, one may witness more profound effects of Plastination in education with newer techniques of specimen processing like light plastination. The cost of resin is an important factor in original standard techniques of plastination procedures and also handling and mounting of heavy plastinated specimens is sometimes associated with limitations. Light plastination, is a cost effective method producing lightweight, rigid, good quality and durable specimens and has facilitated work in this field.[5]

MATERIALS AND METHODS

Materials used for plastination were silicon gel, silicon gun and dissection box. The organs selected for plastination were cerebrum, brain stem, cerebellum, lung with trachea, arch of aorta, common iliac artery with its two divisions and renal artery. Plastination was completed in four steps. The steps were fixation, dehydration, impregnation and hardening. The fixation of organs which was a first step of plastination was done by using 10% formaldehyde solution. The second step was dehydration which was done by using acetone. Dehydration was followed by impregnation. Silicon gel was used for impregnation. The specimen was air dried. In luminal cast plastination, once the silicon gel got hardened, the remaining part of the organ was dissected and removed.

OBSERVATIONS AND RESULTS

This technique provides dry, odorless, durable, nontoxic specimens that are easy to handle and can be stored at room temperature indefinitely. This can be performed in

a short period of time with limited and less expensive infrastructure.

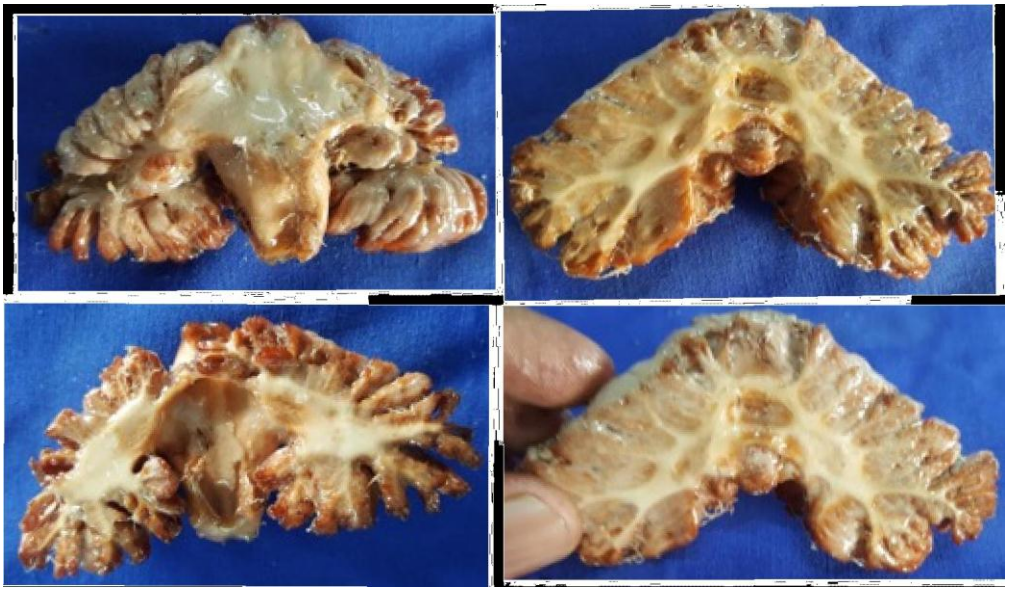

Fig: 1. Plastinate of section of brain stem and cerebellum

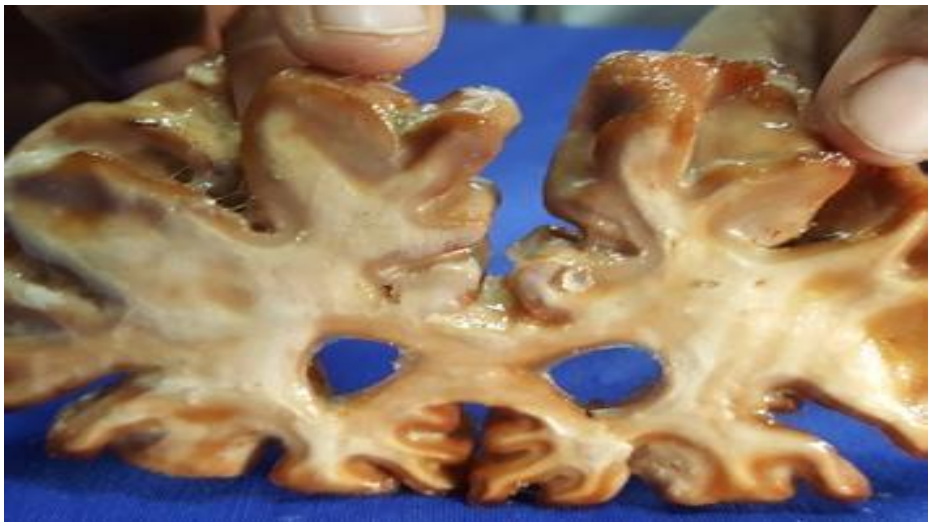

Fig: 2. Plastinate of cerebrum at the level of posterior horn of lateral ventricle.

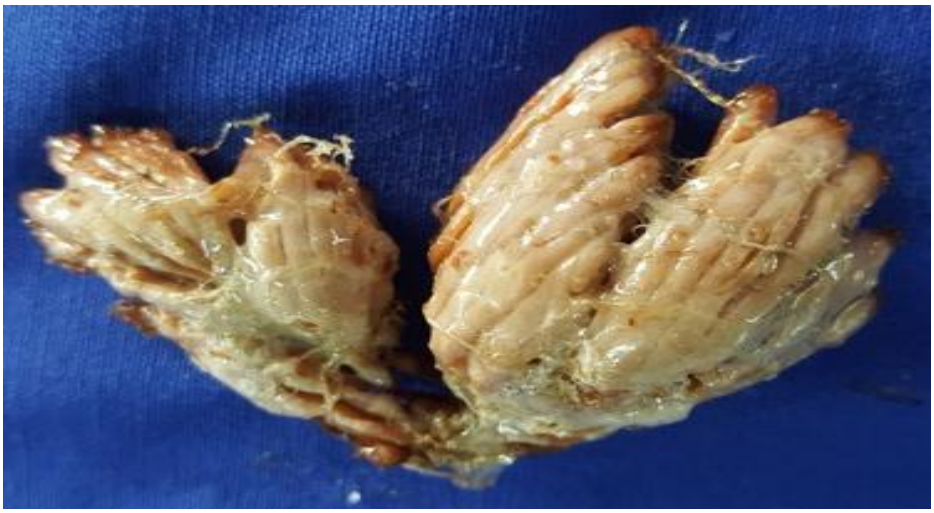

Fig: 3. Plastinate of superior surface of cerebellum.

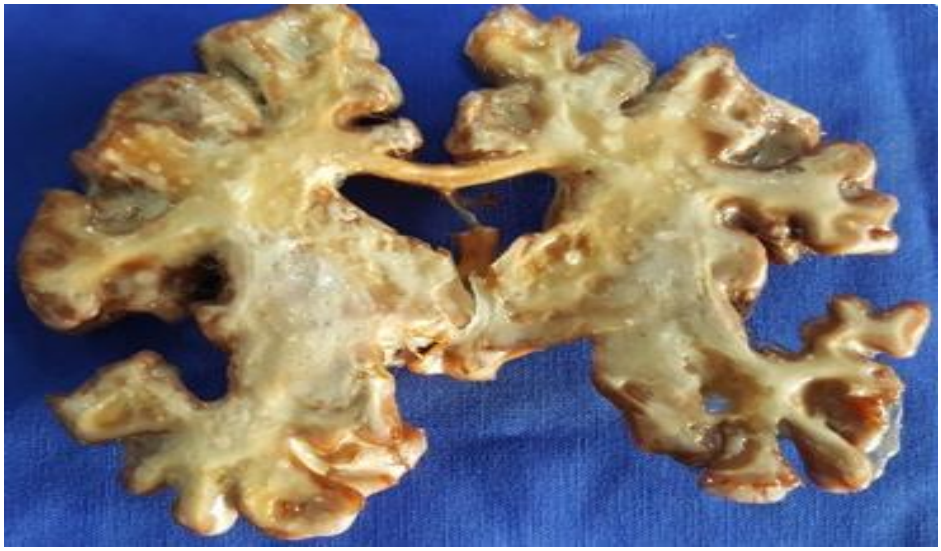

Fig: 4. Plastinate of cerebrum at the level of body of lateral ventricle.

Fig: 5.Luminal cast of renal artery and its division.

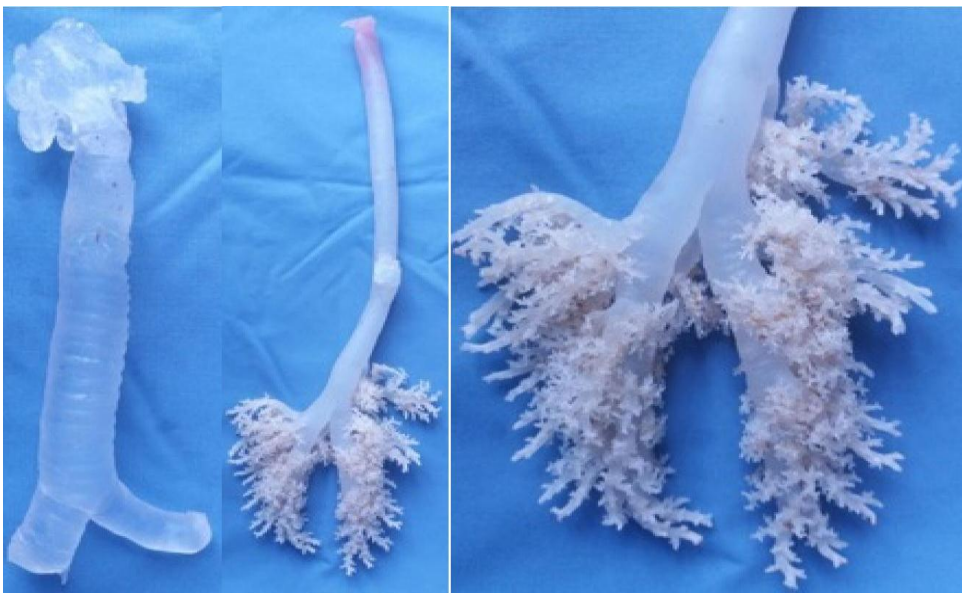

Fig: 6. Luminal casts of tracheobronchial tree.

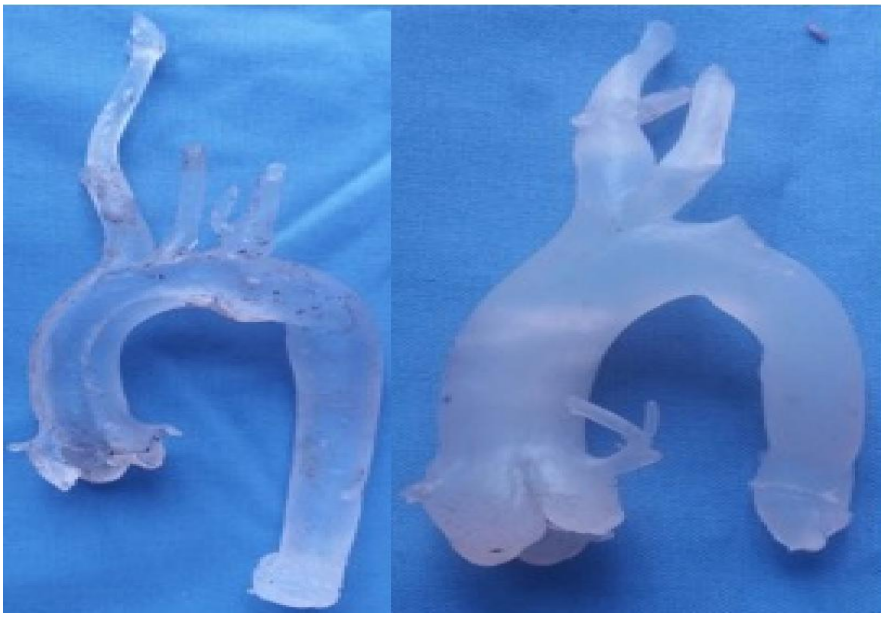

Fig: 7. Luminal cast of arch of aorta and its branches.

Fig:8. Luminal casts of common iliac artery and its divisions.

DISCUSSION

The traditional method of preserving specimens is by saturation with a formalin based solution as open, wet preparations or by enclosure in glass. Open specimens are unpleasant to work with due to formalin vapor emitted and require lots of maintenance as rapidly deteriorate and dry out.

Other methods have been in place for thousands of years to help with the decomposition of the body. Mummification used by the Egyptians is a widely known method which involves the removal of body fluid and wrapping the body in linens. Prior to mummification, Egyptians would lay the body in a shallow pit in the desert and allow the sun to dehydrate the body. Formalin, an important solution to body preservation, was introduced in 1896 to help with body preservation. Soon to follow formalin, color preserving embalming solutions where developed to preserve life like color and flexibility to aid in the study of the body. Paraffin impregnation was introduced in 1925 and the embedding of organs in plastic was developed in the 60s'. Body preservation methods current to the twenty-first century are cryopreservation which involves the cooling of the body to very low temperatures to preserve the body tissues, plastination and embalming. Plastination is used in hundreds of laboratories worldwide to help with the teaching and study of the body.[6] Plastination is useful in anatomy as well as serving as models and teaching tools.

The plastinated specimens retain their dilated conformation by a positive pressure air flow, which allows them to be used to teach both endoscopic technique and gastrointestinal anatomy. The College of Veterinary Medicine in Raliegh, North Carolina used both PC (plastic coating) and PN (plastination) to

investigate and compared the difference in the two methods. The PC method was simple and inexpensive, and the plastinated specimens were more flexible, durable and lifelike than those preserved by the PC method. The use of plastination allowed the use of many body parts such as muscle, nerves, bones, ligaments and central nervous system to be preserved.[6]

Plastination is a combination of science, technological phenomenon and artistic events in association with cultural aspects of life and death. Deep analysis of the artistic and cultural exhibitions of Von Hagens all around the world may appear at first sight as a similar and integral exhibition, but this would be a simplistic view on a very complex and huge mass of cultural aspects hidden through them.[7]

Plastination of body parts is playing a more and more important role in the long-term preservation of tissue and anatomical teaching. There are several plastination techniques with their advantages and disadvantages.

Plastination, also called forced polymer impregnation, is an ideal method for long-term preservation of tissues, whole bodies or body parts. Given this, it is important to obtain written and informed consent from potential donors. Anatomy departments depend on donations, therefore transparency and accurate information given to donors is essential. Plastinates need to be properly stored in a secure place when not in use. Since the use is not restricted to the dissection hall, any utilization outside the lab and by third parties needs to be defined to avoid unethical or disrespectful treatment of human remains.

We displayed the above plastinated specimen to the medical students who came to anatomy departments. Both the formalin preserved specimen and plastinated specimen were kept in anatomy exhibition. After the exhibition, feedback from the students and faculties were taken.

The majority of participants indicated they preferred plastinated specimens to traditional anatomical models. The most common rationale for this preference was the presentation of the real anatomical structures into a model. Other comments regarding plastinated specimens included the ability to demonstrate related anatomical structures 3-dimensionally, ability to provide clearer visuals and easier identification of the structures. Few participants preferred traditional anatomical models to plastinated specimens. The most common suggestions to improve the usability and effectiveness of the plastinated specimens were to color code and tag the structures and to make them more available during the class sessions. For students at any level who are not provided the opportunity to dissect human cadavers, plastinated specimens such as those used in our study might represent the only exposure to actual human anatomy.

At present, plastination has established itself as an indispensable contributor to the teaching armamentarium of clinical anatomists.[8,9] Teachers have accepted plastinated human specimens as superior specimens in relation to synthetic models, on account of their ability to reflect anatomical variations. Plastinated specimens also can be conveniently stored.[10] At present time plastination products not only as a training tool but also as a research mean are increasingly appreciated throughout medical schools.

The potential of plastination lies in its ability to preserve delicate structures and their interconnections, enabling them to be traced microscopically.[11] Even ultrathin plastinated slices can be obtained and have been used to construct precise three-dimensional computer models of anatomical structures.[12] To date, plastination techniques are featured in studies of anatomical organization in the female urethra,[13] esophageal muscles,[14] the carpal tunnel,[15] and ligaments.[16] Their great advantage over traditional histology techniques lies in the ease with which it is possible to move between the macroscopic and the microscopic. However, it appears that many anatomists have not yet realized the revolutionary significance of plastination for anatomical research. In one survey most exhibition visitors claimed to be considerably better informed about their own bodies, although less than half intended to pay better attention to their future physical health.[17]

Preparation of body parts may take considerable time and given that wet specimens can only be used for a few years, it has become more and more important to prepare specimens with care prior to plastination and their future use in teaching over several decades. Plastinated specimens have a long shelf life. Overall, plastination can provide a supplementary method to demonstrate anatomical differences and it is an ideal method for long-term preservation of the most valuable preparations. In addition, plastinates are essential to complement the traditional dissection courses and contribute to a better preparation of postgraduates and clinicians.

This study was a descriptive study introducing innovative teaching/learning tools. We assessed the participant's subjective opinion regarding the usability of and need for plastinated specimens within educational courses. Although the results were in favor of the use and need for plastinated injury models, it is unknown whether the use of these models actually enhanced the students' educational outcomes. Additionally, it is difficult to determine the extent to which these perceived benefits would be present in other student populations. The evaluation of objective outcome measures and the inclusion of additional student populations should be incorporated into future studies assessing the learning efficacy and benefit of plastinated models.

CONCLUSION

Plastination has made massive progresses and have been applied in various fields since its inception. It has been widely used in the field of teaching and it has been used to create samples for demonstration purposes. Apart from these, it has also been proven that, it is a strong preservation method when compared to several other methods such as formalin; Plastination is endorsed by various departments for conservation of specimen. Hence, plastination in recent times have begun to modernize the way in which anatomy is even perceived and projected to students and researchers worldwide.

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