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Plastination a Technique for Preservation of Biological Specimens – Review

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ABSTRACT

Plastination is a technique for the preservation of human and animal tissues of body parts for teaching and research. it used more than 40 medical and dental colleges in throughout the world. The plastinated specimens are more use full in the field of anatomy, pathology and surgery and all so the plastinated specimens can be displayed in all museums for the public.

Introduction

Plastination is a unique method for the preservation of human and animal tissues for teaching and research. The Plastinated specimens are dry, odorless, non-toxic, durable, cost effective, easily handlable and storable manner. Although it is difficult to prepare a well plastinated specimen, but it is most promising method to preserve the specimens as an alternative to formalin preservation[1].

Plastination is a technique of body tissue preservation 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 in biological tissues are replaced by curable polymers mostly silicone, epoxy, and polyester which then will harden and finally result in natural looking, dry, odorless and durable specimens[2].

Plastinated specimens are now considered as milestone in medical education. They have become an ideal teaching tool not only in anatomy but also in pathology, obstetrics, radiology and surgery. In recent years there is a growing tendency toward plastinated specimens. Importance of the plastinated specimens as educational, research and cultural tools in the medical world, although there are still arguments on the usefulness of these tools among anatomists[3].

History

Plastination is a technique invented by Gunther von Hagens in 1977, initially as part of his work as a scientific assistant at the Anatomical Institute of Heidelberg University. At first he was seeking a method to improve the quality of renal specimens in the laboratory so he began to experiment with a variety of plastics and finally after a great deal of trial and error on many tissues and organs, the basics of plastination method as we know today was born. The next step could be patenting of the plastination techniques which occurred and then he established his own company namely BIODUR, to promote his works further and provide the wide variety of specimens and chemical agents through one supplier. In 1986, the International Society for Plastination was founded and only after one year the Journal of the International Society for Plastination published. Some years later, Von Hagens established a specific organization at Heidelberg in 1993, namely Institute for Plastination[2].

Principles of plastination

The principle of plastination involves removal of water and lipid from the tissues and their replacement by a plastic (curable polymer). Plastination has been performed with a number of different polymers, the most common being epoxy, silicone rubber, and polyester. To obtain the best results, the polymer must have the following desirable properties[4].

1. It must have lowest possible viscosity in uncured state and should be easy to handle.
2. Its refractive index must differ from that of tissue (unless a transparent specimen is desired outcome).
3. Resin activator mixture (base and catalyst) must have long working time or a relatively long liquid phase life to allow time for impregnation of the tissues.
4. Curing should not be inhibited by presence of tissue.
5. It should have appropriate mechanical properties when cured, that is, rubber like to simulate a natural state, or firm to permit its surface to be ground.
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[5].

Plastination process

It involves four basic steps: (1) fixation, (2) dehydration and defatting, (3) forced impregnation with polymer, and (4) curing of the polymer, followed by finishing and storage.

1. Fixation – Specimen are fixed in a 10% formaldehyde solution, this stabilizes the tissue and prevents autolysis. Specimens can also be dissected and blood vessels injected with a coloured medium to highlight desired structures.
2. Dehydration - Biological specimens have a high water content which must be removed for plastination. This is achieved by a

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process known as Freeze Substitution where the specimens are placed into a cold -25°C solvent such as acetone. Then, over a period of 4-5 weeks the tissue water is slowly replaced by the acetone.

3. Forced Impregnation - The dehydrated specimens are submerged into the liquid polymer and placed under vacuum, hence the term 'Forced Impregnation' has been coined. The vacuum draws out the acetone from the specimen, leaving the polymer in its place.

4. Hardening - The polymer filled specimen is placed into a sealed chamber where it comes into contact with a curing gas. This gas hardens the polymer making the specimen dry to touch in about 48 hours. Curing is complete after several months.

Finishing and storage

Plastinated specimens can be made more appealing by trimming the unwanted areas or flash polymer with a scalpel, a dilute detergent or a lubricant can be applied to clean, and the surface can be made smooth by buffing to get a display specimen. As far as storage is considered required specimens can be mounted on Perspex stands for display purposes and others can be easily stored in plastic bags at room temperature.

Four primary classes of polymer are used, each with its own distinctive properties and appropriate for specific type of specimens[2].

1. Epoxide resins, which become transparent when heat cured, have become the material of choice for preparing body slices.

2. Light cured polyester resin blends yield excellent results for slices of the brain.

3. Polymer – emulsions that turn white when cured are primarily suitable for thicker slices.

4. Silicon rubber cures in gas and remains soft and pliable, and gives specimen life – like appearance.

Silicon based processes are now the most frequently used. Use of silicon rubber preserves the long periods of time required for complete preservation of large tissue specimen and whole bodies[6].

Science of plastination

The scientific value of using plastinate bodies and organs in the teaching environment like in pathology and anatomy is hard to dispute. Use of such plastinate organs gives students more enthusiasm and excitement to study. Besides this there may be students who are allergic to formaldehyde or afraid to touch the corpse placed in dissection halls. Use of plastinated organs may be handled by these students very easily. Another benefit is these specimens can be handled and examined from all angles and comparisons can be made between normal and diseased organs. Such study rarely happens where comparisons can be made side by side. Thus it carries great educational value and also minimizes the cost of buying corpse because plastinated organs are durable for longer period of time. What more can a medical student ask, if there are human body specimens which are so life-like, non-toxic, odourless and retain most microscopic structures which can make anatomy so easy and gives them encouragement to pay more attention to health and change lifestyles to prevent diseases[7].

Even if the plastination technique may seem time consuming, it is a unique method that is worthwhile because the specimens prepared according to this technique are permanent and can be achieved at a relatively low cost[8]. They have proven extremely useful in teaching general gross anatomy[9,10], sectional anatomy[11], neuroanatomy[12,13], pathology[14], surgery[15,16,17], research in embryology[18] and morphological sciences[19].

Advantages

Plastination is useful in anatomy as well as serving as models and teaching tools. Plastination is used at more than 40 medical and dental schools throughout the world as an adjunct to anatomical dissection. Plastination allows students to have hands on experience in this field, without exposure to chemicals such as formalin and chloroform. The use of plastination as a teaching method of animal science, plastination process allows specimens to be studied for a long time and maintenance of plastinated specimens are very easy.

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 technique to prepare gross organ specimens for use in teaching. Collections of plastinates as teaching aids in schools and colleges. This one time investment helps to learn for lifetime.

Plastination exhibitions

The first exhibition of whole bodies was displayed by von Hagens in Japan in 1995. Over the next two years, Von Hagens developed the body world's public exhibitions, showing whole bodies plastinated in lifelike poses and dissected to show various structures and systems of human anatomy. The earliest exhibitions were presented in the Far East and in Germany, and Gunther von Hagens' body world's exhibitions have subsequently been hosted by museums and venues in more than 50 cities worldwide, attracting more than 29 million visitors.

Gunther von Hagens body worlds exhibitions are the original, precedent-setting public anatomical exhibitions of real human bodies and the only anatomical exhibits that use donated bodies, willed by donors to the Institute for Plastination for the express purpose of serving the BODY WORLDS mission to educate the public about health and anatomy. More than 10,000 people have agreed to donate their bodies to Institute for Plastination[20].

A similar exhibition of plastinated bodies and organs is currently on display, as of April, 2014, at Arenas De Barcelona in Barcelona, Spain. It is predominantly composed of plastinated Asian bodies and body parts and the exhibition begins with a primary room, containing samples of embryos and fetus up to the eight-month stage of pregnancy. The exhibition is expected to continue until October, 2014.

Discussion

Plastination seems to have a great future in all fields of training, research and also public culture and instruction throughout the world. New fast and hazardless techniques make it available to many departments of anatomy and pathology. Plastination is a shrine in which even untrained people can look at the body in a new way. It is a mixture of science and art aimed for educational value to both dental and medical students. It has greater potential for the medical and dental students as it helps understand human anatomy in a more enjoyable environment.

Plastinated specimens are also better options to be used in all museums for the students and public. To learn from live and resected tissues was always with hands on nose but its sure with plastinated specimens can be made interesting. Plastination for sure can make a strong memory of anatomy and pathology that will help everyone in their righteous moment.

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