

Plastination - an unrevealed art in the medical science

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Plastination is a technique used in anatomy to preserve bodies or body parts. Even though a major German encyclopaedia (the 19th edition of the Brockhaus Encyclopaedia, 1992) indicates that the word "Plastination" is derived from the Greek (from *plassein* = to shape, to form), the term is, in fact, a creation of Gunther von Hagens in 1978¹. He coined the term because "plastification" already had a fixed meaning in the field of polymer chemistry, and the expression used in the original patents of 1977-1978, was not terribly catchy and was utterly inadequate for popularizing the new technology, particularly abroad.

Although embalming was started in the Egypt more than 4000 BC,² plastination is a newer technique of permanently preserving tissue in a life like state, in which biological specimens are impregnated under vacuum with a reactive polymer, which replaces all water and fat. This method produces plastic bodies or organs which remain very life like, non-toxic, odourless, durable and may be handled for easier examination. However, plastination is in some cases unsuccessful³.

It is a process at the interface of the medical discipline of anatomy and modern polymer chemistry, 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. It permits the preservation of anatomical specimens in a physical state approaching that of the living condition and can also be used for electron and light microscopic studies^{4,7}. The human dead body specimens are also plastinated for teaching purposes in medical institutions.^{5,8}

Procedure

Like most inventions, plastination is simple in theory; in order to make a specimen permanent, decomposition must be halted. Decomposition is a natural process triggered initially by cell enzymes released after death and later completed when the body is colonized by putrefaction bacteria and other microorganisms. The process of plastination is successfully done by halting the decomposition.⁶

Plastination process requires four main steps

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 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 - Next, 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.

A large number of factors should be considered like degree of decomposition, distribution of fatty tissue and amount of blood in the veins. As each individual specimen requires its own unique to preserve the plastinated organ it should be carefully and precisely planned.

At present, the following four primary classes of polymer are used, each with its own distinctive properties and appropriate for specific type of specimens.⁶

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.

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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.³ Other milestones like “Perfusion plastination” makes it possible to purge organ system of blood, fix them and then permeate them first with acetone and then with silicon. The vascular system is then evacuated before curing the specimen via gas perfusion. These plastinates are pliable and light weight because their vascular systems are empty- only their cells are saturated with plastics.

Body World Exhibition

There has been an exhibition of plastinated bodies and organ at Mannheim, Germany in 1997, opened by Professor Gunther Von Hagens and paved the way for continuous exhibitions throughout the world since then.^{9,10}

To date more than 20 million people throughout the world have visited Gunther von Hagens BODY WORLDS (the anatomical exhibition of real human bodies) exhibitions. They have hence become the most successful special exhibitions of all time. This kind of exhibitions teaches medical staff and lay people more about human anatomy, as well as the transience of life.⁷

A Science

The scientific value of using plastinate bodies and organs in the teaching environment like in anatomy is hard to dispute. Use of such plastinated 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 easily. This makes the study livelier. 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.¹¹

An Art

Over the past 20 years the development of plastination has opened up new vistas for gross anatomy. In particular, it has led to a major expansion in the range of human anatomic specimens available for teaching and its potential value in research is increasingly being appreciated. More recently, it has burst into the public arena through what has become known as 'Anatomy Art,' as depicted in the von Hagens exhibition, *Korperwelten* (Bodyworlds).¹²

The exhibitions left the masses speechless. Some 800,000 visitors were counted in Mannheim and similar figures when exhibition travelled to Japan, Vienna and Cologne.

There were 200 plastinated bodies and human body was placed in series thin longitudinal or cross sections. Bodies were opened up to show the positions of bones and organs, in one specimen nerves were coloured yellow, in another there was man carrying his own skin in his arm as coat.¹³ Some bodies were revealing their muscles in action. There was abdomen of pregnant giving access to the foetus in her uterus. Other showed a series of embryos from different stages of pregnancy all this could be possible only with artistic talent.

Debate

The display of plastinated bodies has been the subject for debate. The question still remains unanswered “Plastination: Science or Art?”. Such displays lead to debates, people had mixed feelings and the question had aroused for dignity of dead.

Those who supported the exhibition were satisfied and pointed out its educational value for medical students and emphasized on safe, sanitary, durable properties of plastinated bodies along with effective method of teaching anatomy. Some were even honoured to have their own bodies made plastic after death for the sake of educational displays.

Several spectators were against the display of plastinated bodies and thought it was dehumanizing and deceased ones should not be made centre of attraction for sake of public or education. There were comments like “When you die, you should be allowed to die, not carted around the world as a laminated corpse and rest in peace and not in pieces”.

Many had agreed plastinated bodies are educational medium but shouldn't be displayed to members as an art. For many others it encouraged them to pay more attention to health and change their life style. Now, the question had aroused if plastinated bodies helped many non-medical people to maintain their life standards, know more about the human body, then should it be confined to academics only? Even today this debatable topic is still unanswered.

Its obvious many people come with individual ideas and suggestions but no one is forced to have their own bodies made plastinated after death. So if one wishes there is no harm and shouldn't be a matter of discussion.

Nepalese scenario

In the Nepalese curriculum anatomy is taught and learned in the basic science, initial two years of medical education. Most of the Nepalese medical institutions are far away from this technique in the department of Anatomy. There could be various obstacles in terms of knowledge, information, finance and infrastructures in the respective institutions.

Plastination offers a means of keeping anatomical specimens without the usual problems associated with wet specimens i.e. desiccation, mould and specific storage requirements. Plastinated specimens are clean and odourless, require minimal aftercare and can be stored on shelves or in display cases. These specimens are more durable and robust than wet specimens showing similar features.¹⁴

It has been found that plastinated specimens are superior to those preserved in formalin for teaching pathology to undergraduate medical students.¹⁵

It is high time for the institutes and concerned authority to recognize its importance and introduce plastins in the medical colleges, which would be a great help for the medical students.

Conclusion

Plastination is a shrine in which even untrained people can look at the body in a new way. Indeed it is a mixture of science and art aimed for educational value to both medical student and for public interest. Plastination wouldn't have been so life like and interesting, full of curiosity hadn't there been artistic anatomist.

It has greater potential for the medical students as it helps understand human anatomy in a more enjoyable

environment. Therefore this modern technique needs to be introduced in all the medical colleges of Nepal.

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