Editorial

Real Anatomy for Teaching - Plastination

Plastination is a technique for preserving tissues, organs, and whole bodies for medical purposes and public display. Gunther von Hagens[1,2] invented a form of the method in 1977 at Heidelberg University in Heidelberg, Germany, after he observed medical students struggle working with cadavers that quickly decomposed. Von Hagens' body models, called plastinates, have since become widely used educational tools not only for those studying anatomy and medicine, but also for public audiences (Figure 1). By accurately preserving tissues for use in research and education, the technique has contributed to the fields of medicine, anatomy, and embryology.

Figure 1: Plastinated part of Human Body Head & Neck

Plastination is an advanced scientific technique that makes it possible to preserve the complete organs and bodies exhibited in HUMAN BODIES without their original appearance undergoing any change.

Each of the pieces comprising of the HUMAN BODIES exhibition has been carefully selected by the teaching team, paying special attention to their scientific exhibition and educational interest. That is why the exhibits are displayed as carefully and respectfully as possible, thus avoiding any kind of controversy. Two dates stand out as milestones in the recent history of anatomy: 1869 and 1977. It was in 1869 that the German chemist August Wilhelm von Hofmann (1818-1892) formally identified formaldehyde (though its existence had been reported earlier); and in 1977, Gunther von Hagens published his seminal paper on the preservation of biological specimens by plastination reported by Bickley HC et al.[3] Prior to the discovery of formaldehyde, and its solution in water, formalin, anatomical examination of the human (or indeed any other) body, had to be carried out speedily and preferably in winter, so that the process of putrefaction was slowed. Bodies sold to the anatomy schools by the “resurrection men” (grave robbers) fetched higher prices in winter. Dissections usually lasted three days, with the abdominal and chest cavities dissected on the first day, the head and cranial cavity on the second day, and the limbs on the third, following the body’s own, pre-

ordained order of decay. The most celebrated depiction of a dissection, Rembrandt's "The Anatomy Lesson of Dr Nicolaes Tulp" (1532) is remarkable for the fact that it shows the dissection of the left arm, while the rest of the body remains intact –clearly deviating from the accepted practice of the time for artistic effect reported by Afek A et al.[4]; where as "The Anatomy Lesson of Dr Deyman", painted much later, suggests that in this case, the usual sequence has been followed. The shortage of bodies for dissection and their rapid decomposition inevitably led to other avenues being explored in the quest for lasting anatomical specimens. Small specimens could be preserved in alcohol, suspended in glass jars.

Fragonard injected the viscera and blood vessels of his subjects with coloured wax before dehydration, and then applied a secret varnish that greatly improved their preservation to such an extent that specimens prepared in the 1790s can still be seen in the Fragonard Museum near Paris Degueurce et al.[5]

In the eighteenth and nineteenth centuries, there was, notably in Florence, a flourishing industry producing models in wax. Remarkable examples of the wax model-makers' art can be seen at La Specola in Florence, the Josephinum in Vienna, and in the Gordon Museum at Guy's Hospital in London where the great model maker Joseph Town plied his trade or more accurately, his art for over 50 years. Attempts were also made to reproduce anatomical specimens in other materials such as wood and papier mâché. With the discovery of formalin, anatomical models became much less in demand, (though anatomical and clinical models have enjoyed something of a recovery over the last twenty years or so). For nearly a century, nothing much changed in anatomy until Gunther von Hagens burst on to the scene in 1977. I think it would not be an exaggeration to say that anatomy has been transformed by these two events to a degree not seen since the advent of Vesalius nearly five hundred years ago.

In this process, water and lipids in biological tissues are replaced by curable polymers (silicone, epoxy, polyester) which are subsequently hardened, resulting in dry, odorless and durable specimens. The class of polymer used determines the optical (transparent or opaque) and mechanical (flexible or firm) properties of the impregnated specimen.

Silicone is used for whole specimens and thick body and organ slices to obtain a natural look.

Epoxy resins are used for thin, transparent body and organ slices. *Polyester-copolymer* is exclusively used for brain slices to gain an excellent distinction of gray and white

matter. The technique consists of four main steps:

1. *Fixation* can be done by almost all conventional fixatives.
2. *Dehydration* is achieved mainly by acetone because acetone also serves as the intermediary solvent during impregnation.
3. *Forced impregnation* is the central step in plastination: vacuum forces the acetone out of and the polymer into the specimen.
4. *Hardening (Curing)* by exposing it to a gaseous hardener (silicone), or by UVA-light and heat (polyester, epoxy). Plastinated specimens are perfect for teaching, particularly for neuroanatomy. Silicone plastinated brains are useful because they can be grasped literally and they are almost everlasting. Polyester plastination of brain slices provides an excellent distinction of gray and white matter and thus a better orientation.

Plastination is carried out in many institutions worldwide and has obtained great acceptance, particularly because of the durability, the possibility for direct comparison to CT- and MR-images, and the high teaching value plastinated specimens have.

Methods of Plastination:

1. The Silicone S10 Standard Procedure - *(*S10 for opaque and flexible specimens*)*.
2. The COR-TECH-Room Temperature Procedure.
3. The Epoxy E 12 Procedure- *(*E12 for thin, transparent, and firm body and organ slices**).**
4. The Polyester P35/P40 Procedure- *(*P 35/P 40 for semitransparent and firm brain slices).

The invention of plastination has given medical students and wider audiences an educational tool for the study of anatomy and embryology. Plastinates are used globally in medical and dental schools and have been viewed by more than 25 million people around the world through Body Worlds exhibits.[6] Embryo and foetus plastinates give people the opportunity to examine the structures present during prenatal development.

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References

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