Teaching with the Preserved Body: From Desiccation to Plastination

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Introduction

A theme throughout the history of medicine has been the quest for knowledge about the interior of the human body. Much of this knowledge has come from dissection. The knowledge gained has been disseminated in various ways including the elegant manner presented in the first paper of this symposium: the use of anatomical waxes to preserve structures that in themselves could not be saved. But the wax models were not entirely adequate. Why was this art not continued?

The use of wax models in the 18th century helped overcome two difficulties: 1) the scarcity of cadavers, and 2) the lack of adequate preservation techniques. But waxes, despite their often incredible realism, are a wholly artificial re-presentation of the body, lacking the horror factor brought about by wetness and smell, as Goethe noted, but also lacking the impact factor that Gunther von Hagens has called "unadulterated authenticity," that here is something that was once living. Waxes, for the most part, lack the touchability and immediacy factor. Most are fragile and are meant to be viewed, not handled. Thus, when preservation techniques improved, waxes waned, for preserved bodies could then meet the challenge of cadaver scarcity.

Preservation of the Body

Modern techniques used to preserve the human body for didactic purposes build on methods that began in the time of the Egyptian pharaohs. Desiccation was the primary means of mummification in the Early Dynastic period, and this same general technique was one of the first means used to preserve specimens for teaching, rather than religious, purposes. These desiccated specimens included both individual organs and whole body sets of nerves and vessels. Antonio Marie Valsalva (1666-1723) produced some of the earliest preparations of dried teaching specimens, and his family donated many of these to the Institute of Sciences in Bologna where they were used so extensively they were virtually destroyed. This gave impetus to the beginning of ceroplasty. Honoré Fragonard (1732-1799), who taught at both the medical and veterinary schools in Paris, invented a secret varnish to coat his desiccated specimens. Later improvements came by placing the specimen in alcohol or spirits of wine. The Meckel family of physicians, especially Johann Friedrich Meckel the Elder (1724-1774) and the Younger (1781-1833), prepared a large group of specimens that was quite famous in its day. Many surviving pieces can be viewed in the anatomical collection of Martin-Luther-Universität Halle-Wittenberg. The use of arterial injections, which added a life-like color and preservation of deeper structures, was developed by Frederik Ruysch (1638-1731) and improved by the Hunter brothers, William (1718-1783) and John (1728-1793). Embalming solutions were later developed that were better able to preserve whole bodies. One of the most important of these that greatly improved the quality of teaching specimens was formaldehyde. William Keiller (1861-1931) at the University of Texas Medical Branch in Galveston was one of the first to use this chemical in embalming medical school preparations. Later additions to embalming solutions included phenol and glycerin.

Plastination

A further advancement in preservation of the body was made through the replacement of the remaining fluids in an embalmed body with a polymer. This technique was invented in 1977 by

Dr. Gunther von Hagens (1945-), who called the process "plastination" and acquired numerous patents for the process. This technique again builds on earlier ones. Once the body has been embalmed, a careful dissection is performed to expose the parts chosen for display. Then the body is placed in an acetone bath. The acetone is absorbed through diffusion and dissolves fats. After the body has been thoroughly impregnated with acetone, it is placed in a polymer such as silicon. The acetone is extracted with a steady vacuum, while the polymer is drawn into the body, replacing the acetone. The body is then posed into its desired position, and depending on the polymer used, the plastic is hardened by gas or by heat. The final plastinate has flexibility and a life-like color and lacks the smell or toxicity of other methods.

Plastinates and Pedagogy

As plastinates enter the academic arena, what are their advantages over the other preservation techniques? In comparison to desiccation, the plastinated body can preserve the normal appearance, e.g., color, size and shape, of the living being and the important relationships of organs, vessels and nerves. In comparison to storage in alcohol, the plastinated specimen remains dry, touchable, and is more visible. In relation to embalming, plastination removes the horror factors such as smell and wetness, but the immediacy remains. There is touchability, a sense of authenticity, and, indeed, a certain beauty. The plastinated specimen can take on the same sense of artistry that is apparent in the anatomical waxes.

Plastinates are valuable in the education of health care professionals. They have been used to great advantage as adjuncts in the dissecting lab as well as in residency programs. One is able to preserve excellent dissections, display anatomical abnormalities and disease processes, and also demonstrate the results of various surgical procedures.

But plastinates are also useful in museum exhibits that educate the lay public, not only the highly selective health care professional. This is an important extension of the museums that the parent society of the USCAP was formed to preserve. If the public is well educated, they will not entertain a fear or suspicion of the unknown and will be more inclined to endorse and support medical research. The enthusiasm for Gunther von Hagens' *Body Worlds* exhibits has demonstrated the interest that the public has in being educated about their bodies. Von Hagens' work in bringing medical science to the public can be compared to the programs that Carl Sagan developed in astronomy and Steven J. Gould developed in natural history. Although, these contributions are held in low esteem by some academics, these programs reach far more individuals than those in university classrooms and can have as great or even greater consequences.

With the use of real cadavers, the *Body Worlds* exhibits have engendered controversy from the church as well as from academics, particularly in Europe. The arrival of the exhibits in America has not engendered such a strong debate. The American museums have formed ethics boards that include academics as well as religious and community leaders. This has brought about an understanding and enthusiasm for exhibits that endorse the democratic ideal of providing medical information that is available to all.

Conclusions

The plastinated specimen has brought tridimensionality to teaching in the form of clean, touchable, authentic, non-smelly, non-toxic, non-biohazardous specimens. But is this enough? The remaining presentation in this symposium may provide some answers.

References

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