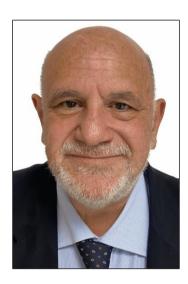_____

Editorial

VIRTUAL ANATOMY OF THE HUMAN BODY: WHERE WE ARE, WHERE WE GO

Guido Macchiarelli

Department of Life, Health and Environmental Sciences, University of L'Aquila, Coppito, Italy

Virtual anatomy is a novel discipline that may be considered part of a greater group of technologies called Medical Simulation (Uruthiralingam and Rea 2020). Simulation in biomedicine is indeed an educational and an operative tool as well, that permits to work on artificial models of reality for experimenting, in a safe and possibly cheap contest, a quasi-real clinical approach to diagnosis and therapy. Simulation is not harmful for patients, it is repeatable countless times, and today it takes advantage of a modern computer technology that allows incredible specular scenarios of real clinical conditions. In addition, today, the introduction of robot and telemedicine technologies allows surgeons to performing mini invasive operation testing and, executing successful surgery.

Animal and human dissections were used for training physicians to the clinical practice since hundreds of years. As well, from the dawn of the history of anatomy, religious people, artists and scholars have felt the need to produce models of the human bodies that could remain unchanged over time as evidence of their existence. Indeed, the conservation or reproduction of bodies not only conferred a material "immortality" to the bodies of the Notables, but also allowed the "archiving" of the bodily features of living beings, in all times.

Today, we have an incredible number of reproductions of the human bodies belonging to the history, created for a variety of reasons, which served for studying human anatomy, investigating anthropological tracts or testing scholar knowledge (Fig.1). Some reliable examples are the Egyptian mummies; the first anatomical tables produced by great artists and anatomists over the period of XIV-XVII centuries; the anatomical machines (1756-64) of Giuseppe Salerno, preserved in the "Cappella di San Severo" in Naples; the obstetric porcelain model of models of Giovan Battista Manfredini (1714-1800); the obstetric simulator called the "machine" of Angelique Marguerite Le Boursier du Coudray (1712-1794); the anatomical wax models of Clemente Susini (1754–1814), Giovanni and Anna Morandi Manzolini (XVIII century) and others. In the last decades, also the Von Hagens' plastinated models could be included in such a wonderful collection of everlasting bodies. The discovery of the X-rays (1895) by Wilhelm Conrad Röntgen and the development of biomedical imaging in the last century, introduced the possibility to apply anatomy to living people, revolutionizing definitely the study of the human body (Doi, 2006).

In modern times, the first to introduce an artificial "sensorial" experience of simulated reality was Morton Heilig (1962) with the Experience Theater (the Sensorama Machine). In 1968, Ivan Sutherland proposed the first simulated reality system, followed by the pioneering example of an interactive computing: the Aspen Movie Map

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(Early Interactive Computing and Virtual Reality) (1978-79) that introduced the early "Hypermedia". The neologism term "Virtual Reality" dates back to 1989, when Jaron Lanier, one of the pioneers in this field, founded VPL Research (Virtual Programming Languages, "virtual programming languages"). The concept of Cyberspace (1970s), closely connected to it, originated in 1982 thanks to the American writer William Gibson.

Figure 1- C. Susini Wax; G.B. Manfredini Obstetrics models, "Macchine Anatomiche" of Giuseppe Salerno; The "machine" of Angélique Marguerite Le Boursier du Coudray.

The National Library of Medicine's Visible Human Project publicly released in 1994 followed by the Visible Woman (1995) (Waldby, 1997), combined the historical experience of the anatomical dissections with the modern computer and imaging technologies, creating the first basis for a virtual model of human body. This project, also thank to the fact that it was made available in public domain, allowed the creation of several reconstructions of the human bodies, derived from real cadavers, but with the incredible possibility of "virtually dissect and rebuilt" them, indefinitely, with a user friendly interface and, with the possibility to immediately compare 3-D cadaver images with correlated radiological/TC frames (Ward et al.2018).

Today, the introduction of computer anatomical tables (such as "Anatomage and Sectra") based on Visible Human Project and other technologies of virtual reality, such us immersive glasses, sensory gloves, etc. (Fig. 2) seems to be of great advantage to the study of the human body anatomy (Moro et al. 2017).

Undergraduate and postgraduate students, and specialists have at their disposal an incredible tool, that increase much the speed of learning and quality of knowledge, improving medical qualification (Bianchi et al. 2020). These

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technologies will surely be improved in a near future by the digital transaction that is developing so fast and, that globally involves all human being activities (Bisht et al. 2019). International scientific literature agrees that direct experience on the corpse is irreplaceable and, that anatomical dissection is of fundamental importance in the medical training; Virtual Reality is however, in my opinion, a necessary complement of morphological and clinical training that should be introduced in all medical schools.

Figure 2- The Visible Human Project; Virtual reality glasses and gloves; Anatomage Table, Sectra Table; 3D rendering of Anatomage human dissectable cadaver.

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