

# Gross Anatomical Modelling: University of Port Harcourt Experience

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## ABSTRACT

Anatomical Modelling is the production of three-dimensional representation of the human body using design from different materials. The concept has been brought to the fore due to difficulty in obtaining and preserving cadavers and the attendant overcrowding in dissecting rooms, variations present in cadaveric specimen and the need to learn layout to recreate common surgical operations. The methodology involved a collaborative research between the Department of Anatomy and that of Fine Arts and Design, using a combination of clinical and studio approach in the production of models of various body parts for students of the Health Sciences and Biology. Transverse sections were also drawn out to demonstrate the three-dimensional view of particular body parts, thereby enhancing the value of the model. It is our hope that more improved models would be produced at more affordable prices and at commercial quantities, to make them more available and meet the needs of our Universities and Health Institutions and in line with the National Universities Commission's (NUC) guideline on saleable research. The products have been exhibited in the Conference of the Anatomical Society of Nigeria which held in Abraka, Delta State in September 2006.

**Keywords:** Specimen, Sculpturing, Commercial

Anatomical modelling was given birth to in the 16<sup>th</sup> century as people sort better ways to illuminate and understand the structure and function of the human body. Over the years anatomical models have provided opportunities for tactile learning in that they can be touched, easy to be moved about, and repeatedly manipulated, hence enhance sensory learning (Dale 1986). Before the discovery of X-rays in 1895, the only practical way of seeing inside the body was to observe an operation or a dissection. Cultural and religious beliefs about dissection at times made the practice illegal. When dissection was eventually accepted for studies in Anatomy, cadavers could swiftly decay due to lack of refrigeration that was not obtainable at that time. Dissections obviously would not have been performed at extreme hot seasons, but during cooler months.

Two dimensional anatomical drawings and paintings could only show the represented parts of the human body on a flat surface enabling the anterior and the lateral views without showing the three dimensional image. The availability of two-dimensional diagram, glasses and schematic drawings such as the cleavage (Langer's) lines in the skin, have in recent past equipped medical practitioners with

ample knowledge that surgical incisions made in the direction of these lines which run parallel to the predominant direction of collagen fiber bundles in the dermis, have less tendency to gape and therefore prevents excessive scarring (Keloid). (Keith and Arthur 1999).

Medical illustrations such as anatomical drawings made by Frank Netter (1906-1991) who was regarded as medicine's Michael Angelo, detailed life-like renderings that became the benchmark by which a lot of medical art is measured and judged. These volumes were devoted to each organ system, which cover human anatomy, embryology, physiology, pathology and pertinent clinical features of the diseases arising in each system.

The first known anatomical representation of the human body was a sculpture called the flayed man, so called because the body is shown without its skin, produced in 1699 by Hodovico Cardi (1559-1613). He attended numerous dissections of cadavers at the St. Maria Nova Hospital of Florence. The flayed man, a statue in red wax measuring 61cm in height, displays all the fruits of his anatomical knowledge. Anatomical Models were designed using wax in the 16<sup>th</sup> century, but by the 20<sup>th</sup> century, papier-mâché, decorative and even plastic models were created.

The interest in the structure of the human body has often been stimulated by the desire of medical profession to explain body dysfunctions such as Rene Laennec who commented that 'no patient's report could suffice to characterize disease ... for a certain diagnosis mediate auscultation is required' by Porter (Suzar, 2006). Thus after world war I, there was significant changes in the doctor-patient relationship and the medical encounter became less collaborative. Medical knowledge was mediated by physicians and anatomical models were used to convey information to patients, while protecting them from the realities of human body.

Several questions were asked before this collaborative effort came to be such as, questioning the effectiveness of the Anatomical Models as a tool for learning. It will be of use to mention that the earliest known models were figures carved and fashioned by people in primitive societies. Some were fetishes, which had religious significance for their makers. One of the oldest historical records of model-making dates back to the Egyptian culture of 400BC (Cabeceiras, 1982).

Mornz (1976) observed that even when the Egyptians carved these works that look like models, they meticulously buried them in royal tombs. This means that access was not given to use these models for medical purposes. Some of these models other wise were placed in the tombs to provide comfort for the spirit of the deceased and were so fashioned that they provided mirror of everyday life and occupation.

Anatomical Models in recent times have been found helpful in the study of Human Anatomy and they came in variety of forms. These forms include:

1. **Non-working Model:** which is known as solid or static model that has no moving parts (Hicks et al, 1970).
2. **Partially Working Model:** This is a model where the operation or functions of only certain parts are represented. Example is a life-sized model of an infant for cardiopulmonary resuscitation (CPR) in which the lungs are inflatable. (Meeks, 1956).
3. **Cross- Sectional Model:** This cut-away model provides a way of representing the interior

of the model, which would not ordinarily be visible. It equally shows internal structures and gives an idea of the parts, which make up the whole. (<http://www.anatomyresources.com>).

## SIGNIFICANCE OF CADAVER IN THE STUDY OF ANATOMY

The period of Renaissance characterized by a rebirth of science, ushered in the first recorded cadaveric dissection as recorded in the work of William of Saliceto (1215-1280), University of Bologna. The study of Anatomy then spread to Universities and by the year 1300 human dissection had become an integral part of the medical curriculum. The interest as at then was on techniques of dissection rather than on further knowledge of the human body (Galenic dogma).

Embalmed corpses could still deteriorate and the ineffectiveness of such embalming produces very unpleasant smell which became a persistent problem. This made Anatomy Professors to lecture from throne-like chairs distancing themselves from the cadavers. The integration of cadaveric dissection into the medical curriculum led to another developmental stage in the study of anatomy and medicine alike in the following ways:

1. Knowledge of the internal structures of the body became greatly disclosed and appreciated.
2. Interest in the study of anatomy expanded as work is being made easier through cadaveric dissection.
3. Anatomy as a subject became more popular and flourished in several universities of the world.
4. Anatomy gradually imbibed theoretical qualities. Thus by the 17th and 18th centuries, Science of Anatomy attained a better acceptance. Exorbitantly, price tickets of admission to the dissection arena were sold to the wealthy and dissections were performed by elegantly robed anatomists who were splendid orators. Executed criminals were the subject for cadaveric dissections.

Cadavers are placed and preserved in Dissecting Halls where they are usually dissected. This brought about an upsurge of the numerosity of Medical and Anatomy Students in the Cadaver Room. How many Cadavers can cater for the large number of students in an Anatomy class almost at the same time?

Gross inadequacy of cadavers in medical schools and colleges, has led to the over crowding in dissection rooms such that the ratio of medical students to a cadaver equals over 30 to 1. This was recorded from the attendance of Gross Anatomy practical classes. Furthermore, some students and patients who suffer from pulmonary lung diseases such as asthma are allergic to cadaveric dissection due to the odour emanating from the various orifices of the human body and from the preservation fluid (formalin).

Obtaining cadavers is not just enough in that they are prone to deterioration and decay even after embalming. This impairs the appreciation of major internal structures especially minute ones of relevance in the study of Anatomy cannot be over emphasized. Anatomical variations observed when dissecting or inspecting prospected specimens have severally rendered medical students confused when the bodies under examination or dissection, do not conform to the atlas or text. Often, the students ignore these variations or inadvertently damage them by attempting to produce conformity. (Bergman et al, 1988)

#### INTELLECTUAL COLLABORATION

The Department of Anatomy in an intellectual collaborative exercise with the Department of Fine Art and Design, both of the University of Port Harcourt, initiated a purposeful search for an alternative method of teaching Gross Anatomy in our Medical Schools to complement the use of Cadavers by developing Human Anatomical Models. There are a thousand and one Anatomical Structures to make, which in totality entail these intellectual collaborations among Scholars of the Human Anatomy discipline and Sculpture. The objectives of this Paper are:

1. To solve the major problems associated with the use of cadavers in the study of Human Anatomy.

2. To expand the tools used in the study of Human Anatomy.
3. To initiate and encourage positive collaborative works among inter-disciplinary Faculties.
4. To produce anatomical models, locally generated in the bid to alleviating the problem of overcrowding in the dissection room of medical schools.
5. As a commercial venture for Revenue Generation

The Anatomist provides the gross anatomical description of the details of a particular body region with the help of atlases while the skilled Sculptor does the sculpturing. The procedure was the act of sculpturing, using an 'outside-in' approach on durable material called Fiberglass. Finishing touches involved alignment, brushing, painting, pigmenting and labelling of the different parts of the model. Fiberglass is a light weight material composed of polyester resin, catalyzing agent, accelerating agent and synthetic fiber mat. Transverse sections were also drawn out to demonstrate the three-dimensional view of particular body parts, thereby enhancing the value of the model.

The negative impression of a living human body part is picked using Plaster of Paris, filled with clay to bring out the positive impression and covered with silicon rubber. The negative impression on the silicon rubber is then filled with fiberglass to bring out the final positive impression of the body part. The model is then smoothened with abrasives, painted with appropriate colours, sealed with transparent cellulose lacquer and finally labelled. The result is the production of Negroid anatomical models for teaching and learning in our medical schools.

#### RESULT OF THE COLLABORATION

This team of experts in Human Anatomy and selected students has been able to add piquancy to learning as they configured, developed, modelled and produced six anatomical models representing different parts of the body. The method hereby adopted for this was a combination of clinical and studio oriented approach to reveal the anatomical modelling of the:

1. Lymph Vessels and Nodes of the Female Breast.
2. Superficial Layer of the Anterior Compartment of the Right Fore Arm.

3. Anterior-Lateral Compartment of the Leg and Foot.
4. Deep Palmar Dissection of the Hand.
5. Upper Arm- Brachial Artery. In situ.
6. Cervical Plexus In situ- Muscles of the Neck.

These models are not excessively heavy, being portable and easy to carry around to the anatomy laboratory, classrooms or anywhere without the medical lecturer or student feeling any discomfort. Effective study of the structures of the human body can be done anywhere and at anytime without difficulty. It is therefore important to note that there are changes from a highly realistic

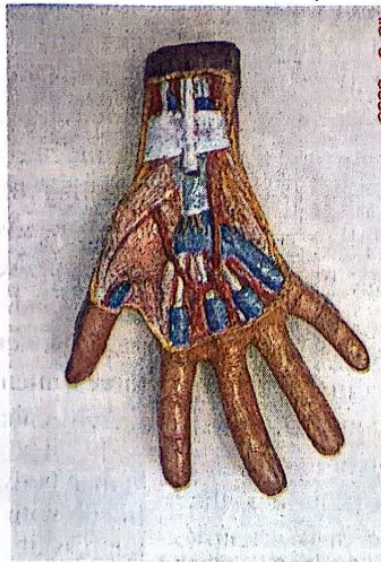
anatomy model to decorative depictions indicating changes in the balance of medical power and of new cultural beliefs about science and medicine in the twentieth century. Thus models had gained commercial success and are presently used by schools, Universities and hospitals, as well as private individuals who could rent models at low cost. One more thing is the affordability of these models and the durability unlike the wax models (See Appendix).

### CONCLUSION

This University of Port Harcourt experience can be said to be a successful one, as these models are actually the first of their kind to be produced in the western regions of Africa. It is therefore believed



1. Anterior View of the Upper Arm Brachial Artery In-Situ



2. Anterior Surface of Deep Palmer Dissection of the Hand.



3. Antero-Lateral View of the Neck Showing Superficial Muscles.



4. Anterior view of the Thoracic Cage Showing Female Mammary Gland.



5. Anterior View of the Right Fore Arm Showing Content of Superficial Layer.



6. Antero-Lateral View of the Left Leg Showing Muscles of Anterior and Lateral Compartment.

that this will open more room for interactive sessions or collaborative works for maximum results such as this Gross Anatomical modelling.

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