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CLINICAL ANATOMY RESEARCH

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***Abstract*—** Anatomy has become a key a part of the visual arts. Basic ideas of however muscles and bones operate and alter with movement are important in drawing, painting or invigorating somebody's figure. Several books are written as guides to drawing the physical body anatomically properly. Architect old master sought-after to boost his art through a much better understanding of human anatomy. Within the method he advanced each human anatomy and its illustration in art. Anatomy is that the science of the structure of the body. Once used while not qualification, the term is applied sometimes to human anatomy. The word comes indirectly from the Greek anatome, a term designed from ana, which means "up," and tome, which means "a cutting".

***Keywords*—** morphology, human physiology, biological sciences.

I. INTRODUCTION

The human body is complex, like a highly technical and sophisticated machine. It operates as a single entity, but is made up of a number of operational parts that work interdependently. Each part is associated with a specific, and sometimes related, function that is essential for the well-being of the individual. The component parts do not operate independently, but rather in conjunction with all the others. Should one part fail, the consequences are likely to extend to other parts, and may reduce the ability of the body to function normally. Integrated working of the body parts ensures the ability of the individual to survive.

Anatomy is the study of the structure of the body and the physical relationships involved between body parts. Physiology is the study of how the parts of the body work, and the ways in which they cooperate together to maintain life and health of the individual. Pathology is the study of abnormalities and how they affect body functions, often causing illness. Anatomy can be defined as the scientific study of the structure and relationship between different body parts and Physiology can be defined as the scientific study of the function of body parts and the body as a whole. The study of the anatomy helps us in supporting the explanations of physiological phenomenon. Anatomy and Physiology together is a multidisciplinary branch which gives the full view of what the human system is capable of and the metabolic process taking place inside the system. The major systems with which it deals are: skeletal system, Muscular System, Nervous System, Respiratory System, Circulatory System, Urinary System, Reproductive system, digestive system.

Anatomy has historically been a cornerstone in medical education regardless of nation or specialty. Until recently, dissection and didactic lectures were its sole pedagogy. Teaching methodology has been revolutionized with more reliance on models, imaging, simulation, and the Internet to further consolidate and enhance the learning experience. Moreover, modern medical curricula are giving less importance to anatomy education and to the acknowledged value of dissection. Universities have even abandoned dissection completely in favor of user-friendly multimedia, alternative teaching approaches, and newly defined priorities in clinical practice. Anatomy curriculum is undergoing international reformation but the current framework lacks uniformity among institutions. Optimal learning content can be categorized into the following modalities: (1) dissection/prosecution, (2) interactive multimedia, (3) procedural anatomy, (4) surface and clinical anatomy, and (5) imaging. The importance of multimodal teaching, with examples suggested in this article, has been widely recognized and assessed. Nevertheless, there are still ongoing limitations in anatomy teaching. Substantial problems consist of diminished allotted dissection time and the number of qualified anatomy instructors, which will eventually deteriorate the quality of education. Alternative resources and strategies are discussed in an attempt to tackle these genuine concerns. The challenges are to reinstate more effective teaching and learning tools while maintaining the beneficial values of orthodox dissection. The UK has a

reputable medical education but its quality could be improved by observing international frameworks.

Within the body there are different levels of structural organization and complexity (Fig. 1). The lowest level is chemical. Atoms combine to form molecules, of which there is a vast range in the body. Cells are the smallest independent units of living matter and there are millions in the body. They are too small to be seen with the naked eye, but when magnified using a microscope different types can be distinguished by their size, shape and the dyes they absorb when stained in the laboratory. Each cell type has become specialized, and carries out a particular function that contributes to body needs. In complex organisms such as the human body, cells with similar structures and functions are found together, forming tissues. Organs are made up of a number of different types of tissue and carry out a specific function. Systems consist of a number of organs and tissues that together contribute to one or more survival needs of the body. The human body has several systems, which work interdependently carrying out specific functions. All are required for health.

II. SCOPE AND IMPORTANCE

Human anatomy Conference provides the scope for opportunities to learn progressed by international scientists and academicians. Human anatomy is primarily the scientific study of the morphology of the physical body. Anatomy is divided into macroscopic anatomy and general anatomy, macroscopic anatomy is that the study of anatomical structures which will be seen by the optic and general anatomy involves the utilization of microscopes to review minute anatomical structures, and is that the field of microscopic anatomy.

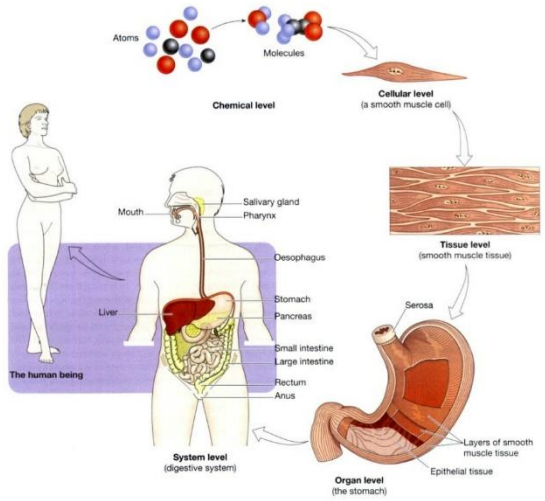

FIG 1. The levels of structural complexity.

Human anatomy is primarily the scientific study of the morphology of the physical body. Anatomy is divided into macroscopic anatomy and general anatomy, macroscopic anatomy is that the study of anatomical structures which will be seen by the optic and general anatomy involves the utilization of microscopes to review minute anatomical structures, and is that the field of microscopic anatomy that studies the organization of tissues in the least levels, from Cell biology (previously known as cytology), to organs. Anatomy, Human physiology (the study of function), and organic chemistry (the study of the chemistry of living structures) are complementary basic medical sciences that are usually educated along (or in tandem) to students finding out drugs. In a number of its aspects human anatomy is closely associated with biology, anatomy and Comparative biology, through common roots in evolution; as an Example, abundant of the physical body maintains the traditional segmental pattern that's gift all told vertebrates with basic units being perennial, that is especially obvious within the backbone and within the ribcage, and which may be derived from the somitogenesis stage in terribly early embryos. Generally, physicians, dentists, physiotherapists, nurses, paramedics, radiographers, and students of bound biological sciences, learn macroscopic anatomy and general anatomy from anatomical models, skeletons, textbooks, diagrams, images, lectures, and tutorials. The study of general anatomy (or histology) is power-assisted by sensible expertise in examining histological preparations (or slides) beneath a microscope; and additionally, medical and dental students usually additionally learn anatomy with sensible expertise of dissection and examination of cadavers (corpses).

III. THE INTERNAL ENVIRONMENT AND HOMEOSTATIS

The external environment surrounds the body and provides the oxygen and nutrients required by all the cells of the body. Waste products of cellular activity are eventually excreted into the external environment. The skin provides a barrier between the dry external environment and the watery environment of most body cells. The internal environment is the water-based medium in which body cells exist. Cells are bathed in fluid called interstitial or tissue fluid. Oxygen and other substances they require must pass from the internal transport systems through the interstitial fluid to reach them. Similarly, cell waste products must move through the interstitial fluid to the transport systems to be excreted. Cells are surrounded by the cell membrane, which provides a potential barrier to substances entering or leaving. The structure of membranes confers certain properties, in particular selective permeability or semi-permeability. This prevents large molecules moving between the cell and the interstitial fluid. Smaller particles can usually pass through the membrane, some more readily than others, and therefore the chemical composition of the fluid inside is different from that outside the cell.

The composition of the internal environment is maintained within narrow limits, and this fairly constant state is called homeostasis. Literally, this term means 'unchanging', but in

practice it describes a dynamic, ever-changing situation kept within narrow limits. When this balance is threatened or lost, there is a serious risk to the well-being of the individual.

TABLE 1.1 Selected Branches of Anatomy and Physiology

BRANCH OF ANATOMY	STUDY OF
Embryology (em′-brē-OL-ō-jē; *embry-* = embryo; *-logy* = study of)	The first eight weeks of development after fertilization of a human egg.
Developmental biology	The complete development of an individual from fertilization to death.
Cell biology	Cellular structure and functions.
Histology (his-TOL-ō -jē; *hist-* = tissue)	Microscopic structure of tissues.
Gross anatomy	Structures that can be examined without a microscope.
Systemic anatomy	Structure of specific systems of the body such as the nervous or respiratory systems.
Regional anatomy	Specific regions of the body such as the head or chest.
Surface anatomy	Surface markings of the body to understand internal anatomy through visualization and palpation (gentle touch).
Imaging anatomy	Internal body structures that can be visualized with techniques such as x-rays, MRI, CT scans, and other technologies for clinical analysis and medical intervention.
Pathological anatomy (path′-ō-LOJ-i-kal; *path-* = disease)	Structural changes (gross to microscopic) associated with disease.

Surgical Anatomy
Surgical anatomy is the study of the structure and morphological characteristics of the tissues and organs of the body as they relate to surgery. It is the application of anatomy in surgical diagnosis, treatment and dissection, surgeons keeps on practicing new aspects of the surgery so that they gets updated with day to day new approaches and remain in good practice.

Forensic Anatomy
Anatomy is a branch of biology concerned with the structure of humans including the skeletal, muscular and skin biology. Forensic anatomy combines this understanding with forensic science techniques to determine the identity of human remains.

Developmental Anatomy
Developmental anatomy the field of embryology concerned with the changes that cells, tissues, organs, and the body as a whole undergo from a germ cell of each parent to the resulting offspring; it includes both prenatal and postnatal development.

Neuro-Anatomy
Neuroanatomy is the study of the structure and organization of the nervous system. In contrast to animals with radial symmetry, whose nervous system consists of a distributed network of cells, animals with bilateral symmetry have segregated, defined nervous systems. Their Neuroanatomy is therefore better understood.

Clinical Anatomy
Clinical Anatomy is a peer-reviewed medical journal that covers anatomy in all its aspects gross, histologic, developmental, and neurologic-as applied to medical practice.

Cell biology
Cells are the structural, functional, and biological units of all living beings.

Renal
The term "renal" refers to the kidney. For example, renal failure means kidney failure. Related topics, Kidney disease; Kidney disease - diet; Kidney failure; Kidney function tests; Renal scan; Kidney transplant.

Metabolism
Metabolism (pronounced: meh-TAB-uh-liz-um) is the chemical reactions in the body's cells that change food into energy. Our bodies need this energy to do everything from moving to thinking to growing. Specific proteins in the body control the chemical reactions of metabolism.

IV. SCOPE AND RELEVANCE OF ANATOMY AND PHYSIOLOGY

In this paper I wish to provide a number of case studies from the faculty of one anatomy department. The illustrations I have chosen do not exhaust the range of clinical anatomy studies underway; they merely point to what is possible. There is nothing definitive about the way in which what I am not able to accomplish reflects the environment in which I function. Nevertheless, I consider there are some lessons here for all anatomy departments and units.

CASE STUDY 1
The underlying drive to carry out this study was provided by osteoporosis with its typical loss of bone density and skeletal fractures, and its significant morbidity. Although a variety of therapies are available to prevent bone loss, none is effective at replacing bone that has already been lost. Consequently, if significant bone loss and the resultant fractures are to be pre-vented, it is important to be able to detect early signs of osteoporosis. The limitation here is that DEXA machines, which constitute the gold standard for measuring bone density, are large, expensive and are usually hospital-based. As a result, they are not suitable for mass-screening programs. An alternative method of assessing bone quality is provided by ultrasound, but early portable machines concentrating on the calcaneus have suffered from a high variability of results. This is due in large part to the positioning of the transducers, which in the commercially available ma-chines are not related to any fixed point on the foot and do not take into account differently sized feet. In an attempt to overcome this limitation, an evaluation was carried out on the calcaneus to determine a site which could

be easily located and where the bone density reflected the density of the whole bone (Burston et al., 1998).

The bone density of dry calcanei and then cadaveric feet was determined using DEXA. From these studies an area 1 cm x 1 cm was found on the calcaneus that reflected the average bone density of the whole bone and exhibited the least variability. This area was then located on cadaveric feet and found to lie [5⁄9] of the way along a line joining the tip of the lateral malleolus to the point of the heel. When ultrasound measurements of cadaveric feet were made using this defined area the variability was significantly reduced. This work was repeated on healthy volunteers with similar results. A further study was then performed using this defined site on premenopausal patients attending a rheumatology clinic, and again the variability of the ultra sound measurements was significantly reduced compared to previous values.

Molecular biology	Surgical anatomy	Developmental anatomy	Cytology	Metabolism			
Cell biology	Molecular biology	Comparative anatomy	Veterinary anatomy	The Blood System			
Reproductive biology	Forensic anatomy	Tissue	Clinical anatomy	Neurons and synapses			
Immunobiology	Plant anatomy and physiology	Human anatomy	Neurobiology	Hormones, homeostasis and reproduction			
Developmental biology	Gastro-endocrinology	Tissue	Embryology	Clinical physiology			
Renal	Cell biology	Neuroanatomy	Cardiovascular	Smooth Muscle			
Endocrine	Human physiology and levels of organization from cellular	Neurodegeneration	Respiratory	Musculoskeletal system			
Reproductive	Neurobiology	Phytotomy	Comparative	Clinical physiology			

This study demonstrates the manner in which a relatively simple clinical anatomy study can be used to illuminate a problem in clinical practice. It can only be embarked upon, however, when there is close liaison between anatomists and clinicians, and when there is an awareness of the limitations of a clinical procedure and of the way in which it can be tackled using the simplest of tools in the clinical anatomist's repertoire. Of crucial importance are the research questions behind such studies, a question which in this instance will be clinically directed. Parenthetically, this case study also utilizes the resource of cadaveric tissue and anatomical expertise within an anatomy department. As we have shown, studies of this nature increase collaboration with clinicians and other anatomists, and can be used to encourage students to undertake small research projects and thereby develop research skills.

CASE STUDY 2

In some instances, anatomical information of value to clinicians may require the use of sophisticated techniques, rather than simply detailed dissection, as valuable as the latter is in many situations. An illustration of the use and adaptation of such techniques is provided by a study of Liliequist's membrane using plastination procedures and scanning electron microscopy as well as dissection. One of the interesting pointers provided by this study is how a technique, like plastination, developed initially for teaching has been adapted for use in research. This demonstrates the close interrelationship between teaching and research, a relationship that should always exist, with the latter constantly informing the former.

In the brain, the subarachnoid space is partitioned into anatomically distinct compartments (subarachnoid cisterns) by trabecular walls; one such wall is Liliequist's membrane. This membrane is an arachnoid trabecular wall in the basilar cisterns and represents an important anatomical landmark in the neuro surgical approach to various brain regions. Despite extensive study, the anatomical characteristics and relationships of Liliequist's membrane remain controversial, due predominantly to the technical difficulties inherent in preserving such delicate structures.

This has revealed both the fine architecture of Liliequist's membrane and its relationships to surrounding structures. These findings, with their depiction of Liliequist's membrane as a double-layered fold of the arachnoid mater and hence different from the arachnoid trabecular walls, are of particular relevance to neurosurgeons who are frequently required to incise and open this membrane to gain access to under lying brain structures. The clinical thrust of this study is evident, but so is its firm basis in modern anatomical investigations. Use of the latter in clinical anatomy research demonstrates that the cross-fertilization of ideas and techniques is crucial to the flourishing of clinical anatomy, which should be viewed as simply another branch of morphological research. Additionally, microscopic approaches have a significant part to play in clinical anatomy, which should no longer be viewed as the exclusive domain of gross anatomists.

The demands of the E12 sheet-plastination technique are considerable, because the process is complicated and time-consuming. What this also illustrates is the very considerable dependence upon technical expertise, because the demands made on plastination in this type of study are precise. Expertise of this type will only be available where it is provided explicitly for research projects or where there is an intimate association between the techniques used in research and teaching. This demonstrates that some clinical anatomy research makes as many demands on advanced

technology as does, say, cell biology research. The professionalism behind the procedures should not be underestimated.

CASE STUDY 3

Small cubes of cadaver tissue with the mandibular condyle at their center were serially cry sectioned and photographed. Two series of sections underwent E12 sheet-plastination and were subsequently photographed. Axial MRI scans were also taken of the temporomandibular joints of two living subjects. A band of fibromuscular tissue (consisting of a varied mix of striated muscle bundles interspersed with fibrous tissue and vascular channels) was found to run horizontally from the medial pole of the mandibular condyle to insert in an area of the temporal bone in front of the squamo tympanic fissure. From this it was postulated that this gleno mandibular band acts as a muscular antagonist to lateral Bennett movement.

The finding that the amount of muscle contained within the band appears to vary could have significant clinical implications. For instance, the amount of muscle within the glen mandibular band might be related to individual liability of the temporomandibular joint to dysfunction. Once again, this study illustrates that for a profitable symbiosis between clinical and anatomical approaches there has to be very close interplay between clinical perspectives and fundamental research goals. These research goals, although informed by clinical considerations, should constitute an ongoing program of research that can be justified in its own right. We recognize no place for accumulating gross anatomical details for their own sake.

CASE STUDY 4

The clinical requirements of physical therapy are evident in the last study to which we shall refer. In this study, the objective was to determine the morphology of the human adult cervical intervertebral disc and its ligaments. The reason for this investigation was that, although evidence existed that the cervical disc was distinctly different from the lumbar disc, most clinical and anatomical texts extrapolated data from the lumbar to the cervical spine. To address this perceived problem, a detailed morphological description of the adult human cervical intervertebral disc was undertaken with the aim of providing formal data on its structure. This study used a microdissection approach on embalmed cadavers to determine both the 3D architecture of the anulus fibrosus of the disc and its surrounding ligaments.

The study found that cervical disc morphology did not match current descriptions in the textbook literature, nor was it similar in structure to that of the lumbar disc. In particular, it was revealed that the cervical annulus fibrosus is more like a crescentic anterior interosseous ligament than a ring of fibers surrounding the nucleus pulposus, as found in the lumbar disc. The newly reported anatomy of the cervical anulus fibrosus has both biomechanical and clinical ramifications. Biomechanical models of the lumbar spine can no longer be accurately extrapolated to the cervical spine, necessitating the development of a new model for the cervical disc. In clinical terms, the current ideas on the etiology and mechanisms of cervical disco genic pain will need to be reassessed.

Whereas a study of this nature, with its large dependence upon adult cadavers, cannot be taken as definitive, it raises serious questions that call for new studies on cervical discs. This finding demonstrates the power of clinical anatomy investigations, contributing as they can to the critical analysis of clinical and functional concepts. Such analyses should not be relegated to the category of 'merely interesting' for dilettantes; they can occupy positions of considerable importance in the ongoing debate on evidence-based clinical practice.

V. CONCLUSION

One may well ask why faculty would wish to be involved in clinical anatomy research, when there is so much other research to be undertaken, most of which has the potential of being far better funded than anything in which a clinical anatomist may be involved. This query is especially pertinent for those of us who also have other research areas in which we are engaged. Inevitably, the driving force varies between us. Many of our graduate students are interested in gross and functional anatomy; in this sense, clinical anatomy research is responding to a market demand. Of even greater importance, all of us recognize the very close relationship between the teaching we undertake and the research underlying that teaching. This applies to gross anatomy as much as to any other area within the anatomical sciences. Hence, an under lying presupposition is that the staff of this Department are not subdivided into two groups: a research group and a teaching group. All faculty are committed to research and teaching. This commitment means that there is ready movement between research and teaching, every effort is made to ensure that research informs all our teaching, and there is also interplay between a variety of academic interests. Gross anatomy is not isolated from the other sub-disciplines that make up anatomy, nor is the teaching of gross anatomy isolated from broader research considerations.

No matter what their academic or clinical back ground, modern clinical anatomists should have a wide range of morphological research skills and be able to adequately use these skills to solve clinical problems. As we have demonstrated, dissection is not the only tool of clinical anatomy research. A variety of techniques is also very useful. The identification of satellite cells is very important in the examination of muscle biopsies as they are one of the key cell types implicated in regeneration of skeletal muscle. It may be debatable whether this project could be described as clinical anatomy, but there can be little doubt that it informs questions of relevance to clinical anatomists.

Clinical anatomy research highlights what should be a fundamental approach: a basis in enquiry rather than in

reading classical texts. The latter should not be used in lieu of research to establish the biological rationale for treatment. The anatomy should always be verified. For instance, many of the musculoskeletal tests and clinical models that were developed in the 1930s and 1940s have been used ever since, despite the fact that their efficacy has not, in almost all cases, been established. The assumption is made that they are valid, yet once they have been tested, serious doubts have been raised over the scientific validity of some of these tests. This, in turn, shows the importance of a research ethos, with its questioning and critical spirit, that may sometimes come into conflict with established beliefs, particularly in clinical areas. The role of the clinical anatomist is to promulgate a questioning scientific spirit, with its willingness to test and challenge accepted dicta. Perhaps the time has arrived when anatomy can reassert its role in clinical investigations. The spirit of enquiry that drove a revolution ary like Vesalius has a great deal to teach clinical anatomists of the twenty-first century.

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VII. DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

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