

FEDERAL UNIVERSITY NDUFU-ALIKE IKWO P.M.B 1010 ABAKLIKI EBONYI

STATE.

STUDENTS' INDUSTRIAL WORK EXPERIENCE SCHEME (SIWES)

A REPORT OF SIX (6) MONTHS INDUSTRIAL WORK EXPERIENCE

AT

FEDERAL TEACHING HOSPITAL, ABAKALIKI

EBONYI STATE

BY

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REGISTRATION NUMBER: FUNAI/B.Sc/14/1157

DEPARTMENT: ANATOMY

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COURSE CODE: ANA 372

**IN PARTIAL FULFILLMENT FOR THE AWARD OF BACHELOR OF SCIENCE
DEGREE (B.Sc) IN HUMAN ANATOMY**

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CERTIFICATION

This is to certify that IJERE ERNEST UGOCHUKWU with the Registration number FUNAI/B.Sc/14/1157 under took his industrial training at Federal teaching Hospital Abakaliki, Ebonyi State.

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DEDICATION

This work is dedicated God almighty and also to my parents

Mr. and Mrs. Fidelis Ijere

ACKNOWLEDGEMENT

The success of my industrial training was made a reality by a team of people who constantly sowed productive seeds into my life and constantly watered the seeds, giving it an avenue for growth.

To the Almighty God for his love, care and constant blessing in my life and the lives of my family and friend. Without him I'm nobody in the face of the earth. I also thank him for the good health all through the period of my industrial attachment.

To my parent, Mr. and Mrs. Fidelis Ijere for incessantly being supportive spiritually, financially and otherwise.

My industry-based supervisors; Mr. dumber, the chief mortician of the mortuary unit; Mr. Agada of the histopathology unit.. Dr. Agbaeze, radiology department. The entire staff who foresaw the success of my Industrial Training especially the Museum Curator, Mr Poki.

My institution-based SIWES coordinator, Mr. Gabriel Akunna and my institution SIWES supervisor, Miss George Itoro for their continuous encouragement., DR Ezimagu, The Head of department of anatomy, FUNAI for the opportunity he granted me to develop my knowledge of anatomy and acquire the industrial skill experience associated with the course.

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CHAPTER ONE

1.0 INTRODUCTION

The student industrial training is the training Programme which forms part of the academic standards in the various degree Programmes for all Nigeria Tertiary Institutions. It seeks to bridge the gap existing between technology and other professional education Programmes in Nigerian Tertiary Institutions.

1.1 HISTORY OF SIWES

In the earlier stage of science and technology education in Nigeria, students were graduating from their respective institution without any technical knowledge or working experience. It was in this view that students undergoing science and technology related courses were mandated for students in different institution in the view of widening their horizons so as to enable them have technical knowledge or working experience before graduating from their various institutions. The Student Industrial Work Experience Scheme (SIWES) was established by the Industrial Training Found (ITF) 1973 to enable students of tertiary institutions have basic technical knowledge of industrial works base on their courses of study before the completion of their program in their respective institutions. The scheme was designed to expose the students to industrial environment and enable them develop occupational competencies so that they can readily contribute their quota to national economic and technological development after graduation. The major background behind the embankment of students in SIWES was to expose them to the industrial environment and enable them develop occupational competencies so that they can readily contribute their quota to national economic and technological development after graduation. The major benefit acquiring to students who participate conscientiously in SIWES are skills and competencies they acquire. The relevant production skills remain a part of the recipient of industrial training as life-long assets which cannot be taken away from them. This is because the knowledge and skills acquired through training are internalized and become relevant when required to perform jobs or functions.

Participation in SIWES has become a necessary pre-condition for the award of Diploma and Degree certificates in specific disciplines in most institutions of higher learning in the country, in accordance with the education policy of government. Operators - The ITF, the coordinating agencies (NUC, NCCE, NBTE), employers of labour

and the institutions. Funding - The Federal Government of Nigeria. Beneficiaries - Undergraduate students of the following: Agriculture, Engineering, Technology, Environmental, Science, Education, Medical Science and Pure and Applied Sciences. Duration - Four months for Polytechnics and Colleges of Education, and Six months for the Universities.

1.2 MEANING OF SIWES

The student industrial work experience scheme (SIWES) is the skills training program, which form part of the approved minimum academic standard in the various degree program for all tertiary institution in Nigeria. It is the gap between practical aspect and theory aspect of either engineering and science technology and other professional educational programs in Nigerian tertiary institution.

1.3 PURPOSE OF SIWES

The objective of student industrial work experience scheme (SIWES) is to enable every student who passed through university or other institution to acquire a practical knowledge of what he/she has learned. Therefore, it is compulsory for every student to satisfy the requirement in his/her academic pursuit.

1.4 AIMS AND OBJECTIVE OF SIWES

- i. To provide an avenue for students in the university to acquire industrial skill and experience in their course of study.
- ii. To prepare students for the work situation they are likely to meet after graduation.
- iii. To expose students to work methods and techniques in handling equipment and machinery that may not be available in the university / Institute.
- iv. Provide student an opportunity to apply their bridging the gap between Higher Education and actual practice.

v. Make transition from the university to the world of work easier and thus enhance students contact for later job placement after graduation.

vi. Enlist and strengthen employer's involvement in the entire educational process of preparing university graduates for employment in industry.

The 6 months Students Industrial Work Experience Scheme (SIWES) which is a requirement for the completion of my course of study, Anatomy, was undertaken at the Federal Teaching Hospital, Abakaliki, Ebonyi state. The Hospital has two branches at the Abakaliki town designated as FETHA 1 and FETHA 2. The Agency's function is to provide quality, accessible and affordable healthcare services; and effective training and research.

CHAPTER TWO

2.1. FEDERAL TEACHING HOSPITAL, ABAKALIKI (FETHA)

Federal Teaching Hospital, Abakaliki (FETHA) is a tertiary health institution in Abakaliki, Ebonyi state, Nigeria dedicated to the provision of quality, accessible and affordable healthcare services; effective training and research in the country.

2.2. Brief History of FETHA

The former Federal Medical Centre(FMC), Abakaliki now Federal Teaching Hospital Abakaliki(FETHA), was established in the 1930s by the then colonial administration to serve as a casual control post for soldiers wounded in the Cameroon theatre of the 2nd World War. It subsequently became the Abakalilik General Hospital, administered successively by then Eastern Regional Government, the then East Central, Anambra, Enugu and finally Ebonyi states Governments.

By 1973, the Hospital had a full complement of Consultant Staff and was approved for training of House Officers. Subsequently, the facilities deteriorated and the progressive loss of Consultant Staff as the East Central state was split into many states impacted adversely on the hospital services. Thus, accreditation for training of House Officers lapsed and services deteriorated to such an extent that the Hospital almost became moribund.

Following the agreement between the Federal Government of Nigeria and the Enugu state Government, the General Hospital Abakaliki was taken over by the Federal Ministry of Health as a Federal Medical Centre(FMC), Abakaliki on March 1, 1990 with Dr. Ekuma Orji as the pioneer Medical Director.

With the takeover, the Hospital made tremendous progress, and assumed all the responsibilities of being a Federal Health Institution. Dilapidated facilities were rehabilitated in 1999, broken down equipments were repaired and modern equipments acquired.

In 2007, Dr. Paul Olisaemeka Ezeonu, the erstwhile Head of services in the Medical Centre took up the mantle of leadership as the Chief Medical Director (CMD). Following this, developments in every department of the Hospital went upscale and has remained so. The Hospital now has Consultants in most Clinical Department and has been able to reactivate wards that were dormant. Attendance has crept up steadily without patient load of about eight thousand monthly. Accreditation for the training of House Officers have been granted.

On its part, Ebonyi state Universty Teaching Hospital was earlier established as a Specialist Hospital, Abakaliki, in the early 1980s. in 1996, following the creation of Ebonyi state and the take-off of the state University, the Specialist Hospital was converted to a Teaching Hospital to serve Ebonyi State University.

On 7th December, 2011, President Goodluck Jonathan upgraded the Federal Medical Centre to a Federal Teaching Hospital and directed that Ebonyi State University Teaching Hospital(EBSUTH) be absorbed into the new mega Teaching Hospital. Thus, became the second branch of the Federal Teaching Hospital, Abakaliki (FETHA 2).

The new Federal Teaching Hospital Abakaliki is indeed mega with retinue of Consultants in various specialties, 604 bed capacity distributed in various departments and a capacity for 250 House Officers. This foremost Health Institution is continually improving in strength, structure and facility and has the establishment of a School of Nursing and Midwifery on its radar.

2.3. *The Organizational Structure of FETHA*

The Federal Teaching Hospital Abakaliki(FETHA) has the Board of Directors as its management body. This Board is headed by the Chief Medical Director(CMD), and also include the Chairman, Medical Advisory Committee(C-MAC), and the Director of Administration. Currently, the Chief Medical Director is Dr. Onwe Emeka Ogah while the Chairman, Medical Advisory Committee and Director of Administration are respectively Dr. Robinson Chukwudi Onoh and Chief C.C.Ogbu. These people are the administrators including the

department heads. Their duties are to manage and oversee the operation of departments, oversee budgeting and finance, establish hospital policies and procedures and perform public relation duties.

Several departments are found at FETHA which can be grouped into four, based on their different duties, as follows:

2.3.1. Informational Services departments—document and process information. They include:

A. Admissions-often the public's first contact with hospital personnel. They check patients into hospital. These responsibilities include: obtaining vital information (patient's full name, address, phone number, admitting doctor, admitting diagnosis, social security number, date of birth, all insurance information), frequently, admissions will assign in-house patients their hospital room. **B. Billing and Collection Departments** - responsible for billing patients for services rendered.

C. Medical Records - responsible for maintaining copies of all patient records

D. Information Systems - responsible for computers and hospital network

E. Health Education - responsible for staff and patient health-related education

F. Human Resources - responsible for recruiting/ hiring employees and employee benefits

2.3.2. Therapeutic Services departments – provide treatment to patients. They include the following departments:

A. Physical Therapy – this provides treatment to improve large-muscle mobility and prevent or limit permanent disability. Treatments may include: exercise, massage, hydrotherapy, ultrasound, electrical stimulation, heat application.

B. Occupational Therapy – Their goal of treatment is to help patient regain fine motor skills so that they can function independently at home and work. Treatments might include: arts and crafts that help with hand-eye

coordination, games and recreation to help patients develop balance and coordination, social activities to assist patients with emotional health.

C. Speech/Language Pathology - They identify, evaluate, and treat patients with speech and language disorders and also help patients cope with problems created by speech impairments.

D. Respiratory Therapy – they treat patients with heart and lung diseases. The treatments might include: oxygen, medications, breathing exercises

E. Medical Psychology – they are concerned with mental well-being of patients. The treatments might include: talk therapy, behavior modification, muscle relaxation, medications, group therapy, recreational therapies (art, music, dance)

D. Social Services – they aid patients by referring them to community resources for living assistance (housing, medical, mental, financial). The social workers' specialties include: child welfare, geriatrics, family, correctional (jail)

E. Pharmacy – they dispense medications per written orders of physician or dentists, provide information on drugs and correct ways to use them and ensure drug compatibility.

F. Dietary - responsible for helping patients maintain nutritionally sound diets.

G. Sports Medicine – they provide rehabilitative services to athletes, teach proper nutrition, prescribe exercises to increase strength and flexibility or correct weaknesses, apply tape or padding to protect body parts and administer first aid for sports injuries.

H. Nursing – they provide care for patients as directed by physicians. Many nursing specialties include: nurse practitioner, labor and delivery nurse, neonatal nurse, emergency room nurse, nurse midwife, surgical nurse, nurse anesthetist.

2.3.3. Diagnostic Services – determine cause(s) of illness or injury. They include the following departments:

A. Medical Laboratory - studies body tissues to determine abnormalities.

B. Radiology – they image body parts to determine lesions and abnormalities. These include the following: Diagnostic Radiology, MRI, CT, and Ultrasound.

C. Emergency Medicine - provides emergency diagnoses and treatment.

2.3.4. Support Services—provide support to entire hospital. This includes the following departments:

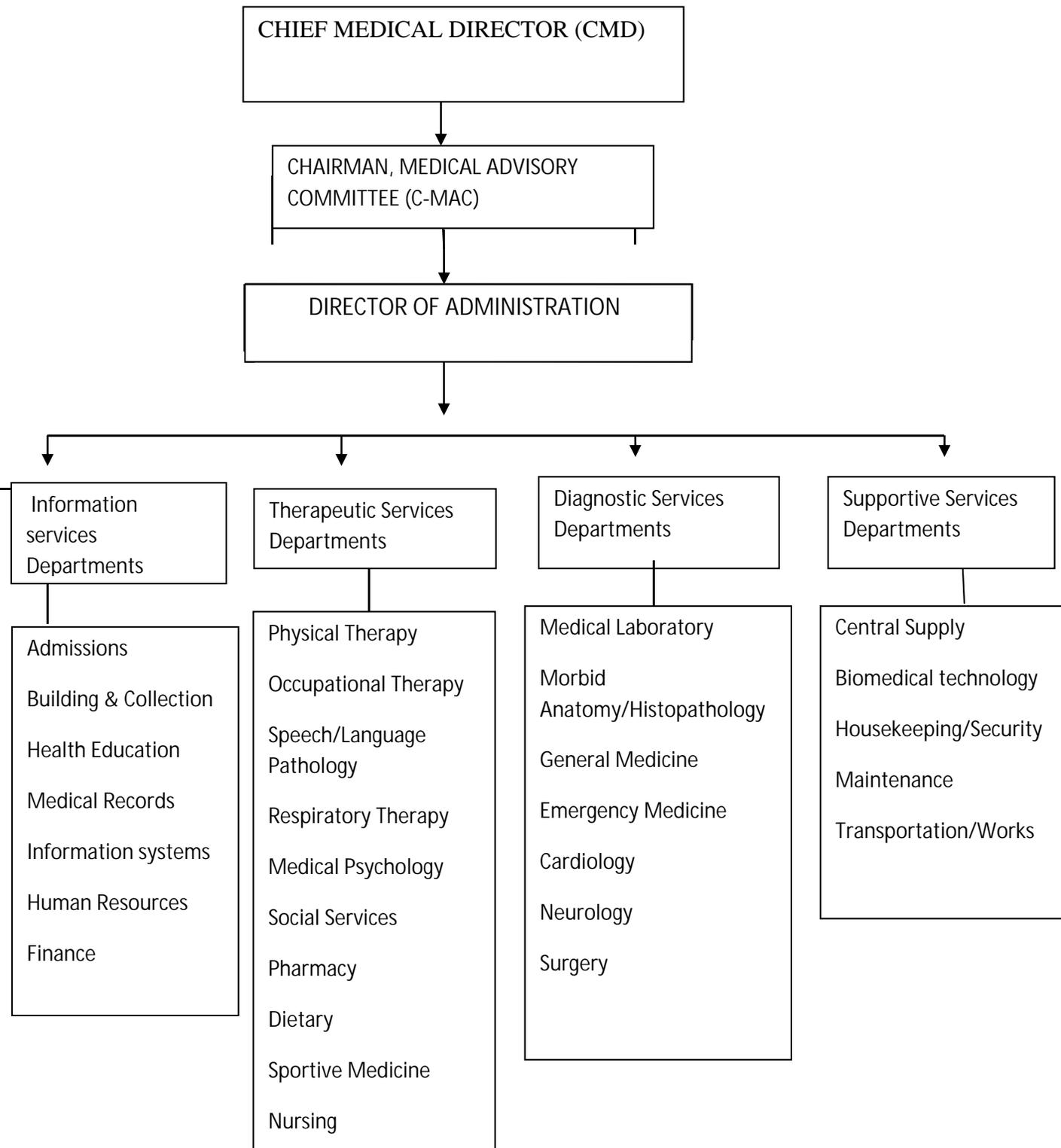
A. Central Supply –they are in charge of ordering, receiving, stocking and distributing all equipment and supplies used by healthcare facility, sterilize instruments or supplies, clean and maintain hospital linen and patient gowns.

B. Biomedical Technology – they design and build biomedical equipment (engineers), diagnose and repair defective equipment (biomedical technicians), provide preventative maintenance to all hospital equipments (biomedical technicians) and pilot use of medical equipments to other hospital employees (biomedical technicians).

C. Housekeeping and Maintenance – they maintain safe clean environment, cleaners, electricians, carpenters and gardeners. This also includes the security personnel.

D. Transportation.

The organizational chart is as shown below:



2.4. INSTRUMENTATION

The different instruments I came across, which are used in the different sections of the Federal Teaching Hospital Abakaliki (FETHA) include:

1. **Embalming tank:** this contains the embalming fluid used in embalming dead human bodies.
2. **Trolley:** the trolley is used as a support for the dead body during embalming. Thus, its function is similar to the table.
3. **Scissors:** this is a cutting tool used to cut part of the muscles during embalment. It is also used to cut other materials like thread during embalming, autopsy and tissue processing.
4. **Syringe:** this is used for injecting embalming fluid into the body during embalment.
5. **Trocar:** this is an embalming device that is made up of an obturator, a cannula and a seal which serves as a portal for the subsequent placement of other instruments like scissors, staplers, etc., during embalment.
6. **Refrigerator:** this is used as a cooling device. It is used to maintain the body temperature of an embalmed body. It is also used to cool tissues after embedding.
7. **Autopsy bench:** this serves as a table for support of the dead body during an autopsy/post-mortem examination.
8. **Scalpel and scalpel blade:** these are used to made neat cut on the body during autopsy and embalming. It is also a very sharp tool for cutting tissues during processing and grossing including threads and twines for museum techniques.
9. **Tray:** this is used to carry the dead bodies unto a trolley during embalming.
10. **Saw:** this is used to cut hard objects such as wood, metallic and plastic substances during museum jar construction.
11. **Vacuum embedding oven:** this is a special oven used for tissue impregnation and embedding of tissues during processing. It melts the paraffin wax and is an electrical tool.

12. **Tissue processing pot:** this is a metallic and special pot used in tissue processing.
13. **Microtome:** this is a machine with knife that is used to cut processed tissues into sections in such a way that it can be stained for microscopy.
14. **Leuckhart embedding mould:** this is an embedding mould which contains two L-pieces of metallic objects and a base plate. It is used for embedding tissues.
15. **Water bath:** this is used as a cooling instrument for tissue blocks after embedding of tissues is carried out during tissue processing.
16. **Staining rack:** this is used as a supporting instrument for microscope slides. Thus, it is used to carry the microscope slides during staining. It has a basket structure and thus, it has spaces where water can easily be drained.
17. **Coplin jar:** this is a covered glass vessel that is rectangular in cross section and grooved inside for holding holding microscope slides vertically during tissue processing.
18. **Mounting tank:** this is a tank which contains fixing and mouting fluid used in mouting of museum specimens.
19. **Work maid:** this is a table used in the museum for construction of museum jar/pot. It is also used as a support tool for other devices used for tissue processing in the Histopathology laboratory.
20. **Museum jar:** this a fully constructed rectangular pot made with Perspex sheet that is used for mounting of museum specimens and display of the specimens used for researches.
21. **Drilling machine:** this is an instrument used in drilling holes in the Perspex sheet during museum jar construction.
22. **File:** this is used to smoothen rough surfaces of the Perspex sheet used to construct the museum jar.
23. **Perspex cutter:** this is a cutting instrument used to cut Perspex sheet during museum jar construction.
24. **T- square:** this is a measuring device which has a T-shape.
25. **Weighing balance:** this is a measuring device that is used to determine the weight of tissues during autopsy and museum jar construction.

26. **Forceps:** this is used during embalment to pick or hold specimens during tissue processing.
27. **Ultrasound scanner:** this is a scanning device used to obtain image of the body by ultrasonography. It has probes or transducer which receives the sound wave and transmit it to the machine and the image displayed on the monitor (screen).
28. **X-ray scanner:** this is an imaging instrument used to conduct plain radiography in the Radiology laboratory. It has an X-ray tube where the radiation is transmitted, and a detector or film which produces the image.
29. **Catheter:** this is a thin tube made from medical grade materials which is usually inserted into the body to perform surging operations in which imaging may be required. It allows drainage of fluids out of the body and injection of contrasts during imaging in the Radiology Laboratory.
30. **Automated Tissue Processor:** this is a machine which processes tissues. It is an electrical device which is used to perform all the stages involved in tissue processing instead of the manual method. The machine saves human energy. By applying a 16 hours procedure, the machine will be started in the evening to be completed in the morning the next day.



COPLIN JAR



STAINING RACK



LEUCKHARK MOULD



SAW



SCALPEL

TROLLEY WITH TRAY



AUTOPSY BENCH



REFRIGERATOR





TROCAR



SCISSORS

SCALPEL



BLADE



CATHETER

FORCEPS



T-SQUARE



PERSPEX CUTTER



FILE



DRILLING MACHINE

WORK MAID



FIG 1a: PICTURES USED IN FETHA FOR MUSUEM TECHNIQUES

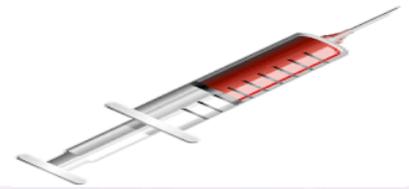
processing

tissues



X-RAY SCANNER

FIG 1b: INSTRUMENTS USED IN FETHA FOR RADIOLOGY



MUSEM

JAR

MICROTOME



EMBALMINGTANK

WATERBATH



VACUUM EMBEDDING OVEN

FIG 1b: INSTRUMENTS USED IN HISTOPATHOLOGY AND MORGUE

CHAPTER THREE

3.0. SKILLS AND KNOWLEDGE ACQUIRED

During my training at the Federal Teaching Hospital Abakaliki (FETHA), I was posted to two departments which include:

1. Morbid Anatomy/Histopathology
2. Radiology.

3.1. MORBID ANATOMY AND HISTOPATHOLOGY

The department of Morbid Anatomy/Histopathology focuses on the study of diseases and disease processes by comparing normal and abnormal human structures and tissues. This department has three units, namely:

1. Histopathology
2. Mortuary
3. Museum.

3.2. HISTOPATHOLOGY SECTION

The activities in this section include:

1. Tissue processing
2. Microtomy
3. Staining

3.2.1. TISSUE PROCESSING

The purpose of processing a tissue is to provide a solid support medium for tissue during section cutting. This is achieved gradually by passing the tissue through series of reagents, which end in a solid medium. If tissue is not supported with a solid medium, thin and even sections cannot be cut. Light is also necessary for microscopy and only thin sections permit light to pass through them. Thus, tissue processing ensures accurate microscopic reading of slides. Many embedding media are available.

There are several ways and techniques used to process tissues for laboratory examination with the intent of making accurate and proper diagnosis. Whichever technique is employed, there are factors which govern the whole procedure, namely:

1. The size and nature of the tissue
2. The substances required to be demonstrated in the tissue
3. Whether the specimen is fresh or preserved
4. The urgency of the examination.

3.2.2. Reception of the tissue specimen

On arrival in the departmental reception, the specimen is checked at the earliest opportunity for the following:

1. That the specimen is for histological examination.
2. That the container is clearly labeled and accompanied by a complete request form.
3. That sufficient fixative is in the container or if the specimen is not in fixative or is in a wrong fluid.

The request form is dated and stamped; the specimen is given an identification serial number which remains with the specimen until all the investigations have been carried out. The pathologist, usually at a set time, will examine the specimen, where necessary describe the macroscopic appearance and select the pieces from which he wants the section to be prepared. A sink and running water are essential in this area usually referred to as the “the cut-up room”. The pathologist requires rubber gloves, sponge, scalpel and scalpel blades, large ham knife, plain and

rat-tooth forceps, probes, scissors, bowel scissors, small bone-saw, steel rule and some means of weighing the specimen (e.g weighing balance).

It is very important for the laboratory scientist assigned to the Cut-up room to write the description of the specimen and record how many pieces that is taken for processing.

3.2.3. Fixation

Before a tissue will be processed, it should be properly fixed using appropriate fixatives so as to prevent the deterioration of tissue thereby maintaining the tissue chemistry and architecture as life-like as possible after death. Thus, fixation is the preservation after death of the shape, structure and chemical constituents of tissues and cells. Soon after death, tissues and cells begin to undergo changes leading to breakdown and ultimate destruction. Such changes may be due to the action of enzymes normally present in the tissues themselves. This is called autolysis (self destruction). The changes can also be due to influence of microorganisms such as bacteria causing decomposition and putrefaction.

Staining quality can be depreciated by inadequate fixation and similarly by poor tissue processing. A good technician must evaluate and determine the processing of choice for each purpose, be it special stains on paraffin, frozen or cell smear preparations.

The ideal fixative should fulfill the following requirements:

1. Prevent autolysis and putrefaction.
2. Should not cause any shrinkage or swelling to the tissue.
3. Should not add or remove from the tissue constituents.
4. Should penetrate the tissues and cells, evenly and deeply.
5. Prevent distortion by any reagents used subsequently.
6. Should impart a suitable hardness and texture to allow for easy sectioning.

7. Should render the tissue receptive of stains.
8. Should be non-toxic, non corrosive and inflammable.
9. Should be cheap and easy to prepare.
10. Should be stable.
11. Should allow for long term storage of specimens.
12. Should allow restoration of some natural colours for museum work and photography.

Fixatives used here is usually 10% Formol saline. Other fixatives include Boun's fluid, Zenker's fluid, Hendenhain's susa, etc.

3.2.4. Decalcification

Tissues which contain deposits of calcium salts are hard. Thin sections cannot be obtained from them because when they are cut, the sections are torn and ragged. They also damage the cutting edge of the microtome knife. Decalcification is the process of removing such calcium salts. Tissue is cut into thin slices with a saw and fixed in formol saline. Thin slices of tissue allow for rapid penetration of fixative and decalcifying fluids. Solutions used for the removal of calcium salts are essentially dilute acids to which may be added other compounds to prevent excessive tissue damage. Examples of these decalcifying agents are nitric acid, hydrochloric acid, acetic acid, chromic and formic acid.

3.2.5. Selection of tissue blocks for sectioning

Following fixation, the selection of tissue for sectioning is done by the pathologist who briefly describes the gross specimen. The description is recorded by, usually, a histotechnologist who also numbers the gross specimen and prepares a tag (a small piece of quality paper e.g Whatman filter paper) on which the number is written in pencil (because ball point pen ink is soluble in alcohol). The tag is placed on a perforated cassette with a snap cover along with the tissue block. The block taken can be up to 3× 2.5cm in area and about 4mm thick. The

histotechnologist notes the number of blocks taken and whether or not the whole gross specimen has been taken. The rest of the gross specimen is placed back in the container of fixative and stored as long as is necessary.

3.2.6. Tissue processing proper

Histotechniques necessitates that thin sections of the fixed tissue be cut. In other that these thin sections may be cut, the fixed tissues must be of suitable hardness and consistency when presented to the microtome knife edge. The desired hardness and consistency can be imparted by infiltrating and surrounding the tissue with paraffin wax, celloidin or low viscosity nitrocellulose (embedding). This infiltration is possible only after the fived tissue has been dehydrated and cleared.

Thus, the various stages of tissue processing include:

1. Dehydration.
2. Clearing.
3. Infiltration
4. Embedding

3.2.7. Dehydration

Dehydration is the process of removing water from the tissue. Graded solutions of alcohol are used. The concentrations range from 70% to 100% alcohol. This 100% alcohol is called absolute alcohol. Tissue has to be passed through low concentrations of alcohol (70%) to high concentration (90% then 100%) because when water molecules mix with absolute alcohol, there is usually turbulence at point of contact, which can distort tissue constituents.

Tissue must be allowed sufficient time in absolute alcohol (usually 2 hours each for three solutions of absolute alcohol) to enable complete dehydration. If dehydration is not complete, the clearing agent and wax will not penetrate tissue. This will lead to poor section cutting.

3.2.8. Clearing

Clearing is the process of removing absolute alcohol from tissue and replacing it with a solvent, which miscible with both absolute alcohol and paraffin wax. Some clearing agents increase the refractive index of tissues; hence, this stage is called clearing. The most commonly used clearing agent is xylene (usually 2 changes of xylene for 2 hours each). Other clearing agents that may be used include benzene and toluene.

3.2.9. Infiltration

This stage is also called impregnation. It is the process of replacing a clearing agent or ante-medium with molten paraffin wax. The paraffin wax completely displaces the clearing agent from the tissue. Infiltration is faster if it is done at a reduced pressure in a vacuum oven.

In this stage, two changes of paraffin wax cut into a steel pots are used, allowing each for 3 hours. In this process, paraffin wax which had a melting point about 54 to 58 degree centigrade is normally used. Temperature of the wax was kept 2 to 3 degree centigrade above the melting point of wax so that the wax will remain as liquid form throughout tissue infiltration process. However, it is important to make sure that the wax did not overheated as it will destroy plastic polymers and cause the cutting process to become more difficult.



FIG 2: Metallic pots containing different reagents used for tissue processing

3.2.10. Embedding

Embedding is the process of burying a tissue in a molten paraffin wax. The paraffin wax becomes a solid firm structure when it is cold. This forms a support medium for the tissue during microtomy.

Here, embedding mould is used (Leuckhart embedding boxes i.e L-pieces is the most commonly used). A separate pot containing the wax is put in the embedding oven together with the two to be used for impregnation. The whole process can be summarized thus:

- 1) Little wax will be poured into the tissue molds and allowed to form at the bottom layer of the molds.
- 2) Tissues will then be picked with warm forceps and put onto the centre of the molds.
- 3) Plastic tissue cassettes will be placed over the mold. More wax will then be added into the molds if necessary. The identification number will be placed by the side of the tissue in the wax.
- 4) The molds were then moved to cold plate for rapid cooling and give fine crystalline structure to wax for better cutting properties.



FIG 3: Structure of a Vacuum Embedding Oven.



FIG4: Leuckhart Embedding Mould

3.2.11. Trimming of blocks

When the blocks have hardened, they are removed from the cold water or refrigerator. The identification number is carefully removed and the block is freed from the mould. Excess wax is trimmed from the block so that so that

the block forms a four sided prism. This prevents the blocks from cracking. The small piece of paper bearing the identification number of the tissue may then be affixed to the block using a hot spatula placed on a Bunsen burner.

A suitable wooden or fibre block may be used as a block holder and the number either written on its side or the paper bearing the number attached to it.

Attachment of tissue block to the block holder

For the tissue block to be cut into thin sections using the microtome machine, they should be affixed firmly to the block holder. The process of attaching the tissue block to the wooden block holder includes:

1. Heat a flat spatula in a Bunsen burner.
2. Place the bottom of the wax block on the spatula.
3. As soon as the wax block starts melting, slide it onto the surface of the wooden block holder so that the sides of the block are parallel to those of the block holder.
4. Press the wax block down firmly and allow to harden. The block is now ready for cutting.

The entire procedure for carrying out tissue processing can be summarized as follows:

10% formol saline ===overnight after grossing

70% alcohol ===2 hours

90% alcohol ===2 hours

Absolute alcohol 1 ===2 hours

Absolute alcohol 2 ===2 hours

Absolute alcohol 3 ===overnight

Xylene 1 ===2 hours

Xylene 2 ===2 hours

Xylene 3 ==2 hours

Wax 1 ==3 hours

Wax 2 ==3 hours

Embed in the molten paraffin wax using the moulds.

3.2.12 MICROTOMY OR SECTION CUTTING

Having fixed, processed and embedded the tissue, the next stage is to cut sections from the block. The machines or instruments used to cut thin sections of tissues are called Microtomes. There are different types of microtomes such as rotary, sliding, base sledge, cambridge rocking, freezing microtomes and cryostat. Among these microtomes, rotary microtome is commonly used. This is because rotary microtome is good in cutting semi-thin sections for light microscopy. Besides that, it can be motorized to facilitate the cutting of plastic embedded tissue.

There are several precautions that need to be considered during cutting sections, such as:

1. Microtome knife **MUST** be set at clearance angle about 5 degrees to prevent compression and chatter in the section.
2. Water bath must be set at temperature about 45 to 50 degrees centigrade. Small amount of alcohol (10% alcohol) or detergent should be added into water bath to reduce surface tension and allow the section to flatten out easily.
3. Floating of tissue section should be done more carefully to prevent water bubbles from being trapped under section. Fold in section can be removed by simply teasing with forceps. Section should be allowed to float for about 30s as prolonged floating will cause excessive expansion and distorting of tissue.

4. Debris and tissue fragment **MUST** be cleaned after each block was cut to avoid any overlap of other debris and fragment on tissue section. This can be done by dragging tissue paper across water surface.



FIG 5: A Rotary microtome.

3.2.13. STAINING

Tissues and their constituent cells are usually transparent and colourless when examined under the light microscope, with little or no differentiation of the various structures. Colouring, in other words dyeing or staining of the sections of tissues makes it possible to see and study the physical features and the relationships of the tissues and their constituent cells. It so happens that different tissues and indeed, different components of the cell, show different affinities for most dyes or stains.

There are several stains but the commonly used is Haematoxylin and Eosin (H & E) stain, preferred because of its availability and its ability to demonstrate the accurate general structure of tissues. The procedure for H & E staining include:

1. Arrange the slides with tissues in a Coplin jar or staining rack.

2. Dewax and hydrate by taking section into xylene and decreasing changes of alcohol (absolutes 3,2,1,90% and 70% alcohols) and then in water.
3. Stain in Haematoxylin solution for 5-10 minutes.
4. Rinse in water for few seconds.
5. Differentiate in 1% acid alcohol with continuous agitation for 10-15 minutes.
6. Wash in running tap water (blueing) or in Scott's tap water for 5 minutes.
7. Counter stain in 1% aqueous eosin solution for 5 minutes.
8. Wash in running tap water for 30 minutes.
9. Dehydrate by passing it through increasing changes of alcohol (70%, 90% and absolutes 1,2,3).
10. Clear in xylene and mount using DPX.



FIG 6: Containers and coplin jar used for staining

3.2.13. Automated tissue processor

Tissue processing can also be done using a machine called Automated Tissue Processor. The machine consist of a time clock, a circular superstructure that contains basket carrier, a receptacle basket and receptacles (stainless steel or plastic capsules), and a circular deck which holds the reagent beakers and plastic baths. Small blocks of tissue are enclosed in the perforated capsules. These capsules are placed in the basket which in turn is attached to

one of the yokes in the superstructure, while it is in the raised position. When the superstructure descends the basket is immersed in the first solution and other reagent beakers are covered preventing evaporation of reagents. To move the basket from one reagent to the next the entire superstructure ascends and descends at scheduled intervals controlled by the time clock. During immersion the basket rotates so the infiltration of fluid into the tissues is optimum. The entire process takes about

16 hours. The machine is started in the evening so that the process is complete in the morning, and embedding is done.



FIG 7: Automated Tissue Processor

3.3 MORTUARY SECTION

The activities in this section include:

1. Embalmmment

3.3.1. EMBALMING TECHNIQUES

Embalment is the art and science of preserving human remains by treating them (in its modern form with chemicals) to forestall decomposition. It is the process of disinfecting, preserving and restoring a diseased human body to a more lifelike appearance as possible. The intention is to keep them suitable for public displays at a funeral, for religious reasons, or for medical and scientific purposes such as their use as anatomical specimens.

Therefore, the three goals of embalming are sanitization, presentation and preservation (or restoration). Embalming has a very long and cross-cultural history, with many cultures giving the embalming processes a greater meaning.

3.3.2. Embalming chemicals/materials

Modern embalming is not done with a single fluid. Rather various different chemicals are used to create a mixture called an arterial solution which is generated specifically for the needs of each case. Potential ingredients in an arterial solution include:

1. **Preservative (Arterial) chemical:** These are commonly a percentage (18%-35%) based mixture of formaldehyde, glutaraldehyde or in some cases phenol which are then diluted to gain the final index of the arterial solution. Formalin refers specifically to 40% aqueous formaldehyde and is not commonly used in funeral embalming but rather in the preservation of anatomical specimens.
2. **Water conditioner:** These are designed to balance the "hardness" of water (the presence of other trace chemicals that changes the water's pH or neutrality) and to help reduce the deceased's acidity, a by-product of decomposition, as formaldehyde works best in an alkaline environment.
3. **Dyes:** These are use to restore someone's natural coloration and counter stain against conditions such as jaundice.
4. **Water:** Most arterial solutions are a mix of some of the preceding chemicals with tepid water. Cases done without the addition of water are referred to specifically as waterless. Waterless embalming is very effective but not economically viable for everyday cases.

3.3.3. Embalming Fluid and its preparation

The Embalming fluid contains the following:

I. Embalming chemicals

a. Phenol – 6gm

b. Borax – 45 gm

c. Sodium Citrate – 45 gm

II. The above three chemicals were boiled to dissolve and then were added to the mixture of liquids containing:

d. Formalin – 5 Litres

e. Methanol – 2.5 Litres

f. Glycerin – 6 litres

III. Water was added in the solution containing I & II to make total solution of 15 litres, which was the embalming solution. this 15 litres can be used to embalmed up to three dead bodies.

IV. Then embalming solution was kept in a jar 4 meter above the ground to facilitate the passage of the fluid due to gravity during infusion.

It is important to note that some Morticians do not add Glycerin to the embalming fluid in most hospitals today due to its cost, but it is very essential as it helps for colour restoration and smoothness of the body.

3.3.4. Purpose of embalming

To temporarily preserve human remains to forestall decomposition and make it suitable for display at a funeral. Embalming for anatomical research and study. A rather different process is used when a cadaver is embalmed for dissection by medical students. The first priority is for long term preservation, not presentation. In short, the

procedure consists of a pre-embalming treatment with blood clot disperser, removal of blood clots, drainage of blood, and arterial embalming via both carotid and femoral triangles of the body. The cadavers are always very well fixed so that they can be used for not only anatomical dissection but also research for the vascular system by vasography, kinematics of the joint and other histologic examinations.

The desired properties required for successful embalming of cadavers for gross anatomy teaching include:

1. Good long-term structural preservation of organs and tissues with minimal shrinkage or distortion;
2. Prevention of over-hardening, while maintaining flexibility and suppleness of internal organs;
3. Prevention of desiccation;
4. Prevention of fungal or bacterial growth and spread within a specific cadaver and to other cadavers in the dissection room;
5. Reduction of potential biohazards (spread of infection to dissection personnel and students);
6. Reduction of environmental chemical hazards (especially from formaldehyde and phenol) in order to comply with increasingly severe health and safety regulations and a new awareness of possible dangers of these chemicals in the workplace; and
7. Retention of color of tissues and organs while minimizing oxidation effects that result in 'browning'.

3.3.5. Pre-embalming

In the hospital, before a body will be embalmed, the children or other relatives of the diseased must provide a death certificate stating that the body is already dead. The body will be registered duly for embalming. Here, the relatives will provide the name, age, sex, religion and the possible cause of death of the diseased, and hence the order to embalm.

3.3.6. Method of embalming

The process of embalming includes the following steps:

1. The body will be disinfected using disinfectants such as JIK. This is also done as part of cleaning the body of dirt or blood spots (for the case of accident victims).
2. Then cotton pads will be inserted in the nose, ears and mouths of the cadaver to avoid any leakage.
3. The cadaver will be stretched to its full length. This is to maintain the anatomical position of the body and for successful accommodation in the coffin during burial or even displays.
4. After the cadaver was stretched to its full extension, an incision will be made in the area of femoral triangle using the surgical blade. This is done in order to locate the femoral artery.
5. Femoral artery will be identified, a trocar – a long, pointed, metal tube will be inserted and a small incision will be made on the artery.
6. The embalming fluid will be infused through the femoral artery by connecting the hose (little tube) from the embalming tank (containing the embalming fluid) to the artery.
7. With the help of syringe, the embalming fluid will be injected in the abdomen, thorax, limbs, muscular part and all the other body cavities. This is usually a day later after the arterial embalment.
8. Embalming fluid will also be infused through the superior orbital fissure to preserve the brain matters. The anus and vagina may be packed with cotton or gauze to prevent seepage if necessary. Incisions and holes made in the body are sewn closed or filled with trocar “buttons.” The body is washed again and dried.

For burial purposes, the following will be required:

11. Nails are manicured, any missing facial features are molded from wax, makeup is used on the face and hands, and head hair is styled.
12. The body is dressed and placed in the casket (fingers are glued together if necessary).

For bodies used in learning, after spending more than two hours, the body will be sent to the embalming tank containing 10% formalin to make them ready to be used in the teaching and learning of Human Anatomy in the dissection room after 10 days of storage.

Therefore, the actual embalming process usually involves four parts:

Arterial embalming which involves the injection of embalming chemicals into the blood vessels, usually via the femoral artery or right common carotid artery. Blood is drained from the right jugular vein. The embalming solution is injected using an embalming machine and the embalmer massages the cadaver to ensure a proper distribution of the embalming fluid. In case of poor circulation, other injection points are used.

1. Cavity embalming which involves the suction of the internal fluids of the cadaver and the injection of embalming chemicals into the body cavities, using an aspirator and trocar.
2. Hypodermic embalming which involves the injection of embalming chemicals under the skin as needed with the help of syringe.
3. Surface embalming, which supplements the other methods, especially for visible, injured body parts. It includes stitching of injured parts, closing the mouth (if found open), filling the nose with cotton wool, arranging the breast together with thread (for females if found scattered due to its large size). It also includes the use of pomades and other beautifying agents on the cadaver (usually for display purposes).

3.3.7. Specialist embalming

Decomposing bodies, trauma cases, frozen and drowned bodies, and those to be transported for long distances also require special treatment beyond that for the "normal" case. The recreation of bodies and features damaged by accident or disease is commonly called restorative art and is a sub-specialty inside embalming, although all qualified embalmers have some degree of training and practice in it. It is on these cases that the benefit of embalming is startlingly apparent.

Embalming autopsy cases differs from standard embalming as the nature of the post mortem irrevocably disrupts the circulatory system with the removal of organs for examination. In these cases a six point injection is made via the two femoral arteries, axillary vessels and common carotids, with the viscera treated separately with cavity fluid in a viscera bag.

Long-term preservation requires different techniques, such as using stronger preservative chemicals, multiple injection sites to ensure thorough saturation of body tissues, and in the case of a body to be used for anatomical dissection taking no blood drainage and doing no treatment of the internal organs.

3.4. MUSEUM SECTION

The museum is a very important unit of the hospital where pathological and normal anatomical specimens are stored and displayed. All teaching hospitals and colleges of Pathology have Museums which serve many functions: permanent exhibition of common specimen for undergraduate and postgraduate teaching purposes, illustrating specimens of rarity, permanent source of histological material and for gross and microscopic photography.

The major activity here is construction of museum pot/jar for mounting of anatomical and pathological specimens.

3.4.1. Basic museum techniques

Any specimens for museum are handled by following steps:

1. Reception
2. Preparation
3. Fixation
4. Restoration
5. Preservation

6. Presentation

3.4.2. Reception of the Specimen

Any specimen received in the museum should be recorded in a Reception book and given a number followed by year (e.g. 32/2013). This number will stay with specimen even after it is catalogued in its respective place. This number is written on tie-on type label in indelible ink and is firmly attached or stitched to the specimen. The reception book should contain all necessary information about the specimen (clinical, gross and microscopic findings).

3.4.3. Preparation of the specimen

An ideal specimen is received fresh in unfixated state. However, it is mostly obtained from pathology laboratory after being examined, thus will already be formalin fixed. If planning to use a specimen for museum, part of it can be kept without disturbing for museum, e.g. in kidney it can be bisected and one half kept aside for museum.

3.4.4. Fixation of the specimen

The objective of fixation is to preserve cells and tissue constituents in as close a life-like state as possible and to allow them to undergo further preparative procedures without change. Fixation arrests autolysis and bacterial decomposition and stabilizes the cellular and tissue constituents. The fixatives used in museums all over the world are based on formalin fixative technique, and are derived from Kaiserling technique and his modifications. Kaiserling recommended that the initial fixation be a neutral formalin (KI) solution and then transferred to a final preserving glycerin solution (KIII) for long term display. Colour preservation is also maintained with these solutions.

2.4.5. Kaiserling's Technique

The specimen needs to be kept in a large enough container which can accommodate specimen along with 3-4 times volume of fixative. Specimen is stored in the Kaiserling I Solution for 1 month depending on the size of the

specimen. The specimen should not rest on bottom or an artificial flat surface will be produced on hardening due to fixation.

Kaiserling I Solution: Fixing fluid

1. Formalin – 400mL
2. Potassium acetate - 60g.
3. Potassium nitrate - 30g.
4. Distilled water - Make up to 2 Litres

Specimens may be transferred to this fluid after fixation in Formol saline or be directly fixed in it.

3.4.6. Restoration of specimen

It is required to restore the specimens, as they lose their natural color on fixation.

The recommended method is the Kaiserling II method. It involves removing the specimen, washing it in running water and transferring to 80% ethyl alcohol for 10 minutes to 1hour depending on the size of specimen. The specimen is then kept and observed for color change for around 1- 1.5 hrs. After this step, specimen is ready for preservation.

3.4.7. Preservation of specimen

The recommended solution for this step is Kaiserling III. This is the final solution in which the specimen will remain for display. It is based on glycerine solution.

Kaiserling III Solution: Mounting fluid

1. Sodium acetate – 100g.
2. Glycerin – 300mL
3. Formalin – 5mL

4. Distilled water Make up to 1Litre.
5. 0.4% Sodium hydrosulphite is added immediately before sealing the jar so as to maintain the colour of the mounted specimen. Thymol crystals may be added to prevent moulds and camphor may also be added for purity of the fluid.

*The fluid will be allowed to stand for 2 – 3 days before using to ensure proper mixing of chemicals.

3.4.8. Instruments found in the museum

There are several instruments used in the museum. Some of which are:

1. Twine – for stitching.
2. Stitching needle (avived or straight).
3. Perspex sheet – base of the pathology museum (for construction of tissue jar).
4. Perspex cutter – for cutting Perspex sheets.
5. T-square – for cutting a straight edge.
6. Painter's brush/artistic brush.
7. Water filter – used to filter mounting fluid.
8. Electrical drilling machine with drilling bit.
9. Work maid (bench or table) for the pot construction.
10. Other instruments include weighing balance, saw, files (rough and smooth), mould (made of soft wood), screw driver, scissors, forceps, syringes, funnels, brain knife, scalpel blades, measuring cylinder, glass pipette, stirring rods, markers, stainless trays and artery forceps.



FIG 8: Some of the instruments used in the museum

3.4.9. How to Pot a Tissue/Mounting of specimen

The whole processes involving in potting a tissue can be summarized as follows:

1. The width, length and thickness of the tissue will be measured.
2. The Perspex sheet is measured and cut to desired size to match with the tissue specimen using the Perspex cutter.
3. The Perspex sheet is placed on the mould and aligned properly.
4. The edges of the Perspex sheet are cleaned with chloroform.
5. The Perspex cement is then applied on those edges and the entire surfaces joined to form the six surfaces (the top plate is the only surface that will not be joined here). This will be supported with weight to ensure thorough joining and may be allowed overnight.
6. The centre plate will be cut from the Perspex sheet and should be 1.0cm smaller than the pot.
7. The stoppers (either 2 or 4) are made to hold the centre plate firmly to avoid dangling of the tissue when mounted.
8. Two close holes are bored on the centre plate using the drilling machine and the specimen is fastened to the centre plate firmly using the twine.
9. The constructed pot is checked for leakage(s) by pouring water into it.

10. The fastened tissue is put into the jar/pot and filled (to about 1.00cm lower than the length of the pot) with the mounting fluid from the water filter tank.
11. The pot is covered with the bottom plate using the chloroform and Perspex cement; and two holes (orifices) are drilled at the edge of one side of the bottom plate using the electrical drilling machine.
12. The pot is then filled to the brim with the mounting fluid through the two orifices using syringe.
13. It is then allowed overnight to evacuate properly the air bubbles trapped into the pot during the course of the filling. This must be done because air reacts with the chemicals used to form carbonic acid which can lead to deterioration of the tissue specimen being mounted.
14. The next day, the pot is then refilled with the mounting fluid (to fill the gap that was formerly occupied by air bubbles) to the brim using the syringe.
15. Two Perspex rods will be constructed to close the openings used to fill the pot with the fluid using the chloroform and Perspex cement. This is allowed for about 2 hours or overnight so that the cement can set, and after which, the part of the rods lying outside the pot is cut out.
16. The outcroppings all around the pot (mostly the edges) are filled to smoothness. The pot is now ready for use and display.



FIG 9: A fully constructed pot containing the human brain.

3.5. RADIOLOGY DEPARTMENT

Radiology is a medical specialty that uses imaging techniques to diagnose and treat diseases within the human body. This branch of science deals with the use of radiant energy in the diagnosis and treatment of diseases. Radiologic anatomy is the study of the structure and function of the body using the medical imaging techniques. It is an important part of clinical anatomy and is the anatomic basis of radiology. Being able to identify normal structures on radiographs (X-rays) makes it easier to recognize the changes caused by diseases and injuries.

Familiarity with medical imaging techniques commonly used in clinical settings enables one to recognize congenital anomalies, tumors, and fractures.

3.5.1. MEDICAL IMAGING TECHNIQUES

The major imaging techniques or imaging modalities used in the radiology department for diagnosis of diseases include:

1. Plain radiography (X-ray imaging).
2. Computed Tomography (CT).
3. Ultrasonography (US).
4. Magnetic Resonance Imaging (MRI).
5. Nuclear Medicine Imaging (NMI).

All imaging modalities have the same principle components, which include:

1. An object to analyze (i.e. the patient)
2. An energy source (i.e. light or sound waves)
3. A detector (i.e. x-ray film, MRI detector)

Each modality has advantages and disadvantages and therefore is best suited to the investigation of particular clinical scenarios.

3.5.2. PLAIN RADIOGRAPHS

Plain radiographs (or x-rays) are the first line in imaging technology. X-rays are inexpensive, quick, specific, and highly available.

How they work

X-rays contain high-energy photons which are transmitted through a patient at a specific angle (the view), toward a cassette containing photographic film. The x-rays cause the film to darken. The relative density of the structures that are imaged modulates the number of photons that reach the film; dark areas on the completed radiograph indicate areas of low density (i.e. air) and light areas indicate a high density structure (i.e. bone). A dense tissue or organ produces a somewhat transparent area on the X-ray film or detector (and is said to be radiopaque and usually appearing whitish) whereas a substance of less density is radiolucent (and is dark on the X-ray film).

X-ray is not very good at visualizing soft tissue because these appear as **shades of grey** that are difficult to interpret. Substances which absorb x-rays (such as barium or iodine), can be injected or inserted in the body to improve the delineation of non-bony structures. This specialty of X-ray imaging is called Contrast study. The lower intestine can be visualized using a barium enema; joints are seen with the help of arthrography.



FIG 9: An X-ray Machine

Advantages of plain radiographs (X-ray imaging)

X-rays are inexpensive, widely, and they provide an excellent initial evaluation of bone detail and anatomic relationships. They are the most specific imaging modality.

Disadvantages of plain radiographs

X-rays are not very sensitive: they are less sensitive to bone marrow pathology than bone scan or MRI, and less sensitive to cortical bone pathology than CT scans. They are not optimal for evaluating soft tissue. Some x-ray views (e.g. pelvis; lumbar spine) result in relatively large radiation exposure to the patient.

The associated use of contrast agents adds additional risks including allergic reaction.

The radiation dose of x-rays varies based on the body part imaged, the technique used and the views required. The “effective dose” of radiation, used for quantification and comparisons of risk, is the dose averaged over the entire body. This can range from a chest x-ray (0.1 mSv – which corresponds to 10 days ‘natural’ background radiation) to a barium enema (4 mSv or the equivalent of 16 months of environmental radiation exposure).

In the vast majority of cases, the benefits of conventional xray imaging outweigh the radiation risk, however the risk to benefit ratio should always be considered. Physicians should be able to justify each x-ray request in terms of how the anticipated result might alter clinical outcome or treatment.

3.5.3. COMPUTED TOMOGRAPHY (CT)

CT (Computed Tomography), provides a more detailed radiographic picture of the anatomical area that is imaged. It is often used as a follow-up to an abnormal radiograph or is requested when radiographs fail to completely answer the clinical question. CT scan provides very good bone detail and improved soft tissue resolution.

How it works

CT uses a rotating X-ray beam to pass through “slices” of the body. These are detected by a computer and recreated into axial images. These images can be reconstructed in any plane or three-dimensionally to demonstrate the anatomy and pathology.

Advantages of Computed Tomography (CT)

CT gives images on slices. This image can be reconstructed axial to coronal image. CT also show images on windows (soft tissue window and bone window).

Disadvantages of CT

CT uses higher radiation than X-rays (about 50 times higher than X-rays).

CT scans deliver the highest radiation exposure used in current medical imaging practice. This occurs because multiple x-ray scans are used to construct the images. A CT scan generates approximately 10 mSv, or the equivalent of 3 years 'background' radiation. CT scans require a more careful risk and benefit evaluation than conventional radiographs.

3.5.4 ULTRASOUND

Ultrasound uses sound waves to provide real-time imaging of anatomic structures. It is most commonly used to evaluate soft tissues and in obstetrics. Ultrasound is useful for identifying joint effusions and has limited use in the evaluation of other skeletal structures. It is commonly available, low cost, and offers the advantages of real-time imaging without any radiation risk.

How it works

Sound waves are transmitted from a probe placed in contact with the skin. These waves are reflected back to a receiver. The characteristics of the returning sound waves are used to generate a picture, as different tissues cause the sound waves to be reflected differently. Ultrasound produces a tomographic (cross-sectional) image.



FIG 10: Ultrasound Machine

Advantages of Ultrasound

- Highly available
- Real-time
- No ionizing radiation
- Good soft tissue contrast

Disadvantages

- Results vary with expertise of technologist and radiologist.
- Ultrasound waves cannot penetrate bone or air.

3.5.5 MRI (MAGNETIC RESONANCE IMAGING)

MRI stands for Magnetic Resonance Imaging. It is the “gold standard” of soft tissue imaging, and has the added advantage of requiring no ionizing radiation.

How it works

The MRI machine creates a large external magnetic field, which causes the protons (H⁺) in the body to polarize and align with the magnet. A special radio-frequency pulse is applied and causes the protons to 'tip' out of alignment into a higher energy state (excitation phase). The pulse is relaxed, the protons remove to the lower energy state, during which they emit energy. Each tissue has slightly different characteristics due to the proton environment (relaxation phase). This differential is used to generate the MRI image.

Each tissue-type has a unique appearance on MRI which helps the radiologist to identify anatomy and pathology such as trauma, infection, inflammation or tumour.

Image contrasts

Depending upon when the emitted signal is detected coming from the patient, different tissues will have different imaging properties. If the signal is detected very shortly after the beginning of the procedure, the image that results is called "T1 weighting". In a "T1 weighted" image, fat is bright, fluid and other soft tissue is intermediate grey and bone/fibrous tissue is dark.

If the signal is detected later, the image that results is called "T2 weighted". In a "T2 weighted" image, fat is dark, and fluid is bright. Pathologic conditions often contain more "free" fluid and will also be bright.

Advantages of MRI

- Excellent soft tissue contrast
- Multi-planar
- No radiation

Disadvantages of MRI

- Expensive
- Poorly available as MRI scanners are not available in all hospital imaging departments
- Poor bone detail
- Uncomfortable procedure (long, noisy, claustrophobic) for some patients
- Children may require general anesthetics because of the need to lie still for extended periods of time
- Cannot be used if patient has certain metal or electronic implants such as pacemakers, heart valves, aneurysm clips.

- Safety in pregnancy has not been established.

3.5.6. NUCLEAR MEDICINE IMAGING (NMI)

Nuclear Medicine Imaging techniques provide information about the distribution or concentration of trace amounts of radioactive substances introduced into the body. Nuclear medicine scans show images of specific organs after intravenous (IV) injection of a small dose of radioactive material. The radionuclide is tagged to a compound that is selectively taken up by an organ, such as technetium-99m methylene diphosphonate for bone scanning.

This technique includes the positron emission tomography (PET) scanning and Single-photon emission computed tomography (SPECT) scanning. The PET scanning uses cyclotron-produced isotopes of extremely short half-life that emit positrons. This scanning is used to evaluate the physiologic function of organs, such as the brain, on a dynamic basis. Areas of increased bone activity will show selective uptake of the injected isotope. Images can be viewed as the whole organ or in cross sections. SPECT scans, on other hand, are similar to PET scanning but use longer lasting tracers. They are less costly, but require more time and have lower resolution.

This Nuclear Medicine Imaging (NMI) also uses high dose of radiation but has partial resolution compared to other modalities discussed above. It is only used for pathological conditions such as pulmonary embolism diagnosis. Thus, cannot be used for normal anatomical imaging.

Bone Scan

Bone scan is used to detect metabolically active bone. This is useful to detect occult fractures, infections, and bony metastases which may be difficult to detect with other imaging modalities. **How it works**

A radioactive tracer (Technetium 99 is commonly used) is injected intravenously. This accumulates in areas of bone undergoing rapid metabolic activity.

Over a period of several hours, the tracer passes from the vascular system to bone. A gamma detector is used to produce an image. “Hot spots” occur where the radionuclide has accumulated, demonstrating areas of high metabolic activity.

Advantages

- Early detection of metastases and infection
- Detection of occult fractures not visible on plain radiographs
- High sensitivity

Disadvantages

- Moderate radiation risk (more than plain films but less than CT)
- May be difficult to interpret in children due to the presence of metabolically active growth plates
- Not available in all imaging departments; may not be available off-hours
- Poor specificity.

CHAPTER FOUR

4.1. CONCLUSION

This industrial training has really provided me with the practical knowledge of all the things I have been taught in the classroom. It has also afforded me the basic practical and theoretical knowledge that I may not have gotten from the lecture room. It has made me to feel the reality of my course of study.

The training gave me the opportunity to have a feel of what it would be after my graduation when I start working. Thus, it has given me the experience of work and the required attitude in any place of work that I may be employed into tomorrow.

From the knowledge gained from this training, I can now do the following:

1. I can properly embalm a dead body.
2. I can perform autopsy on a dead body to ascertain the cause of the death.
3. I can properly fix and process tissues
4. I can properly embed tissues into blocks and section them.
5. I can construct a tissue pot for museum display.
6. I can produce the image of any organ using medical imaging techniques like ultrasound and plain radiographs (X-rays).

More also, the training has connected me to different persons and health workers in the hospital, whom I associated with as friends during the programme.

4.2. RECOMMENDATION

There is no doubt that some students during the industrial training do not usually have the opportunity of being exposed to the aim of this programme either as a result of nonchalant attitude of their industrial supervisors who are not willing to teach them or intentionally do not attend the SIWES but seeing the it as a period to do other businesses. Therefore, I recommend that those external supervisors, from both the institution of the concerned student and from ITF, should regularly visit the industrial attachment areas so as to find out if the training is suitable and functional; and at the same check if the student is rally participation in the training.

I also recommend that ITF should liaise with some establishments where they will take up students for industrial training. This will help students who find it difficult to find attachments or who end up in the areas where they do nothing.

Finally, I recommend that ITF should always pay students (as they proposed) during this programme, and also urge establishment pay the student(s) that may be attached to them. This will motivate the students in the participating more effectively in their activities because some students do not attend the programme due to lack of finance to sustain them in the area of attachment.