INAUGURAL LECTURE SERIES 332

RECONSTRUCTION OF THE HUMAN FRAME AND THE ORTHOPAEDIC SURGEON

By

INNOCENT CHIEDU IKEM
Professor of Orthopaedic Surgery
and Traumatology

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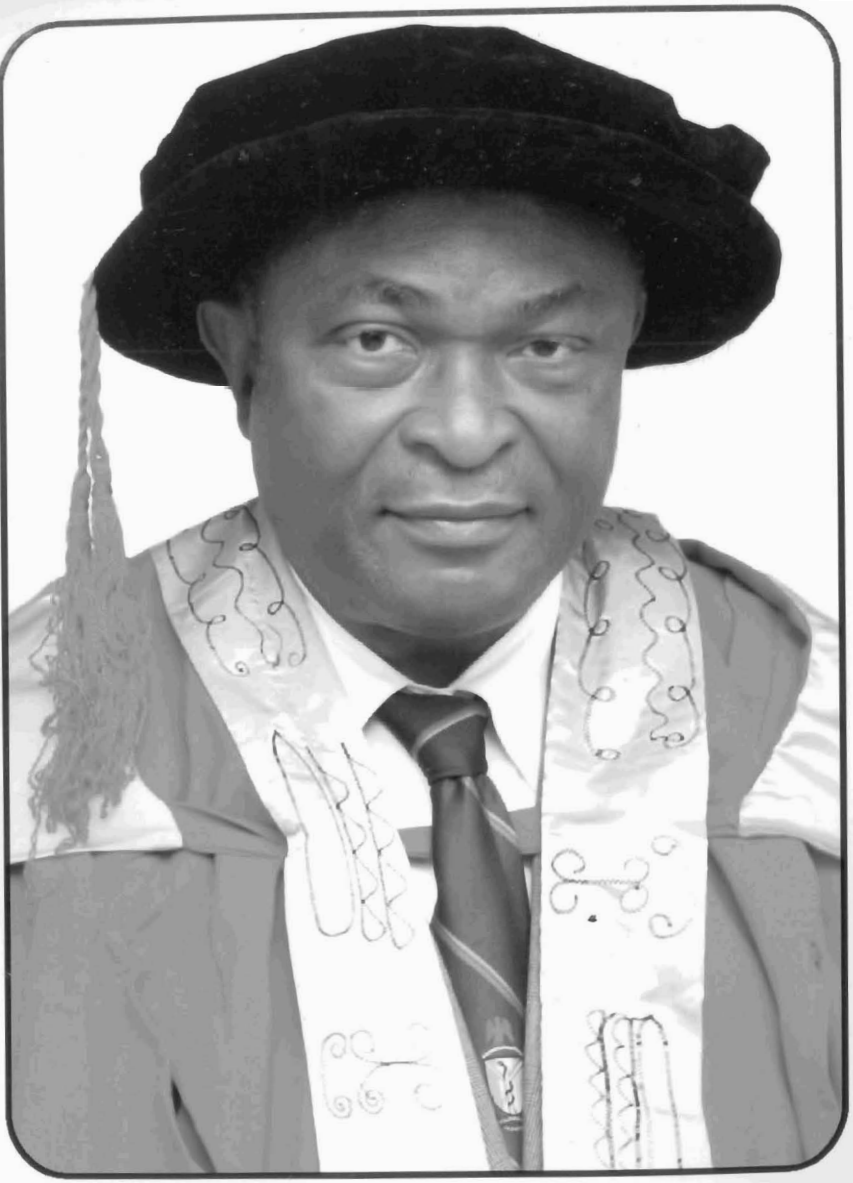

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An Inaugural Lecture Delivered at Oduduwa Hall,
Obafemi Awolowo University, Ile-Ife, Nigeria
On Tuesday 12th February, 2019

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RECONSTRUCTION OF THE HUMAN FRAME AND THE ORTHOPAEDIC SURGEON

Preamble

Mr. Vice Chancellor Sir, and other Principal Officers of Obafemi Awolowo University, Ile-Ife, here present, Members of the University Governing Council, Members of Senate, Provosts, Deans, Directors, Heads of Departments, Academic and Non-academic/Administrative Members of Staff, Professional Colleagues, Students of this great University, invited guests, President National Postgraduate Medical College of Nigeria. Professor Opubo Benedict da Lilly-Tariah. It is with great pleasure and a sense of gratitude that I stand before this noble audience today.

I will also like to pay tribute to my late parents of blessed memory, Mr. Peter O. Ikem and Mrs. Victoria. T. Ikem who despite all odds, clearly understood the value of education. They would be extremely glad to know that their keen interest and investment in education produced three full Professors and the rest being top flyers in their chosen professions. Also, my siblings who have been very supportive in my pursuit of education particularly the patriarch, of the Ikem family of Onicha-Ugbo, Delta State, Diokpa Anthony Ikem I say thank you so much.

Mr. Vice Chancellor Sir, I feel highly honoured to be given the privilege to deliver the 332nd Inaugural Lecture of this Great University. The Department of Orthopaedic Surgery and Traumatology is even more honoured to have the rare privilege of delivering inaugural lectures in quick succession within the same department. Professor O. O. Adegbehingbe delivered the 331st inaugural lecture while I am today delivering the 332nd inaugural lecture titled "**Reconstruction of the Human Frame and the Orthopaedic Surgeon**". At the completion of Medical School, It was customary to assume that your choice for residency training to pursue specialist education and subsequent academic career will be the subject you excelled the most. At graduation from Medical

School, I won the best overall student prize in Paediatrics, endowed by the Paediatrics Association of Nigeria (PAN). With this background, I told all my family members and friends that I will pursue my residency training in Paediatrics. However, by the completion of the National Youth Service, the first job I got exposed me to Orthopaedic Surgery by default. Within the next few months of exposure, the practice of Orthopaedic Surgery got the best of me that I was willing to forgo the pursuit of Paediatrics. The flame of enthusiasm the experience sparked is still very much aglow in me till date. When I came to Obafemi Awolowo University Teaching Hospital Complex to be interviewed for the residency training, the then Head of Department of Orthopaedic Surgery and Traumatology. Mr. Z. O. Alabi FRCS of blessed memory could not hide his excitement that someone with my background could show so much interest in Orthopaedic Surgery and Traumatology even before the formal commencement of my residency training program. After the completion of my residency training, I joined the services of Obafemi Awolowo University, Ile-Ife, in 2000 to start my career as an academic staff in the Department of Orthopaedic Surgery and Traumatology. I was pronounced Professor effective 1st October, 2010. I presently serve as the Head, Department of Orthopaedic Surgery and Traumatology.

INTRODUCTION

An inaugural lecture is an occasion of immense significance in the career of any academic staff of the University to inform colleagues, the university community and the general public of their work to date, including current research and future plans. An inaugural lecture also provides newly appointed professors with an unprecedented opportunity to showcase and summarise their research and career and to acknowledge the work of their close colleagues and mentors. My set plan to deliver my inaugural lecture have been postponed a couple of times because of some uncertainties within the university system.

History of Orthopaedics.

The modern term *Orthopaedics* stems from the older word *Orthopaedia*, which was the title of a book published in 1741 by Nicholas Andry (figure 1), a Professor of Medicine at the University of Paris (Andry Nicolas, 1741). The term *Orthopaedia* is a composite of two Greek words: *Orthos*, meaning "straight and free from deformity," and *Paidios*, meaning "child." Together, Orthopaedics literally means straight child, suggesting the importance of paediatric injuries and deformities in the development of this field. Interestingly, Andry's book also depicted a crooked young tree attached to a straight and strong staff, which has become the universal symbol of Orthopaedic Surgery and underscores the focus on correcting deformities in the young (**Figure** 2).

Figure 1: Nicholas Andry

While the history of the term is relatively recent, the practice of Orthopaedics is an ancient art. Orthopaedic Surgery is a rapidly advancing medical field with several recent advances noted within Orthopaedic sub-specialties (Ninomiya et al, Sabharwal et al, Ricci et al 2015), basic science (Rodeo et al 2014), and clinical research

(Pugley et al 2015). It is important to recognize the role of history with regards to innovation and research, especially for young trainees and medical students interested in a particular medical specialty. More specifically, it is important to understand the successes and failures of the past in order to advance research and practice, and ultimately improve patient care and outcomes.

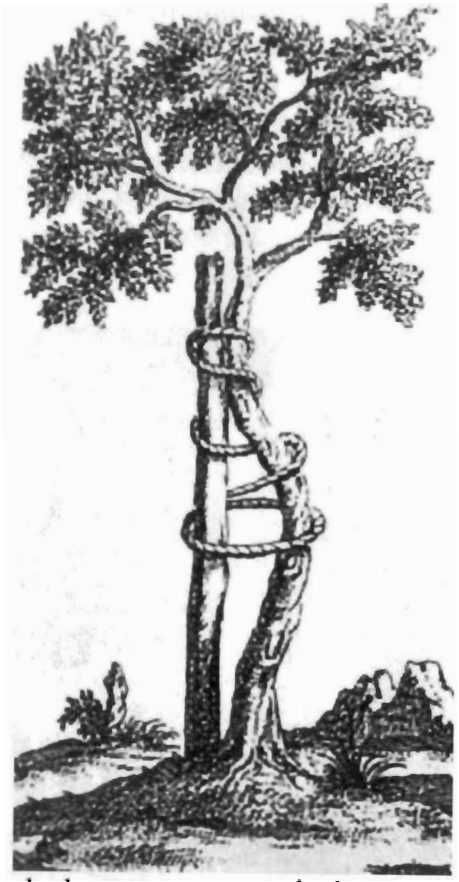


Figure 2: A crooked young tree attached to a straight and strong staff

Ancient Orthopaedics

While the evidence is limited, the practice of orthopaedics dates back to the primitive man (Colton, 2009). Fossil evidence suggests that the orthopaedic pathology of today, such as fractures and traumatic amputations, existed in primitive times (Brakoulias,

2016). The union of fractures in fair alignment has also been observed, which emphasizes the efficacy of non-operative orthopaedics and suggests the early use of splints and rehabilitation practices (Brakoulias, 2016; Bishop, 1995).

The Modern Era: In the 20th century, rapid development continued to better the control of infections as well as develop and introduce novel technology. For example, the invention of plain radiograph (x-ray) in 1895 by Wilhelm Conrad Röntgen improved our ability to diagnose and manage orthopaedic conditions ranging from fractures to avascular necrosis of the femoral head to osteoarthritis (Brakoulias, 2016; Levine, 2013).

Brunschwig and Botello, in the 15th and 16th centuries, advocated the removal of non-vital tissue from wounds that did not progress properly. The significance of Paré's discoveries were largely unrecognized during his day (Trueta 1943). It remained for Desault, in the 18th century, to re-establish the making of a deep incision to explore a wound, remove dead tissue, and provide drainage. It was he who adopted the term debridement. His pupil, Larrey, extended the principle and included the issue of timing. The sooner debridement is done after wounding, he contended, the better the result. All these principles are still taught to our students at all levels and are part of our treatment protocol in our hospital today.

However, the scope of Orthopaedic Surgery, has outgrown the limitation originally proposed by Andre, who confined his thesis to the prevention of crookedness in children. During this century, the interest in Orthopaedic problems was wide spread. Orthopaedic Surgery has greatly moved away from manual energy sapping instrumentations to automated powered tools. These have made the practice of Orthpaedics a delight not just for the male surgeons but with a significant number of female entrants. A modern Orthopaedic Surgeon and Traumatologist must be well conversant with the properties of metallurgy and basic principles of engineering to be able to effectively and safely insert these

implants in the human bone. The bio-mechanic of any Orthopaedic procedure must be very sound. Some of the basic tools and implants we use in modern Orthopaedics include: Mallet (Hammer), Chisel, Osteotomy, Screw Driver, Power Drill, various shapes of Plates & Screws, Nails, etc shown in figure 3.

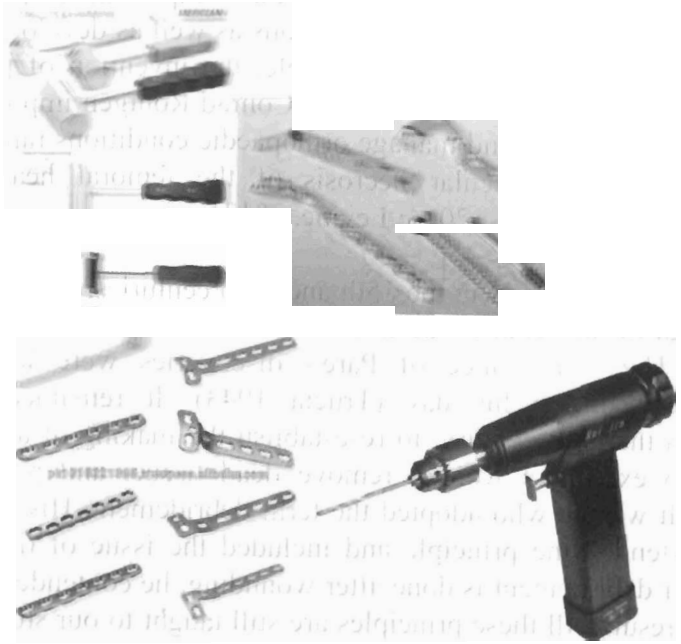


Figure 3: Some Orthopaedic Tools and Implants.

Orthopaedics in Ife

The Department of Orthopaedic Surgery and Traumatology, Faculty of Clinical Sciences, College of Health Sciences, Obafemi Awolowo University (formerly Faculty of Health Sciences, University of Ife), Ile-Ife was established in 1983. Clinical facilities utilized at the onset included, Seven Day Adventists Hospital Ile-Ife, Ife State Hospital Ile-Ife, General Hospital Ilesha and Wesley Guilds Hospital Ilesha. The pioneer head of Department was Mr. Zaccheus O. Alabi (FRCS) (Figure 4). Dr E. A. Bamgboye was also on the staff. They both worked diligently to lay excellent foundation for the department. Professor Lawrence

M. Oginni took over headship from 1992 - 2005 and moved the department to great height.

Today, our Department stands tall among the community of Orthopaedic Surgeons in Nigeria as the leading Orthopaedic Department among Nigerian Universities. As at today we have four professors and two senior lecturers. The members of academic staff continue to inspire our students to take up the specialty of Orthopaedic Surgery and Traumatology. Our students have continued to excel in the postgraduate exit examinations of both the West African College of Surgeons and the National Postgraduate Medical College of Nigeria by winning prizes at various times.

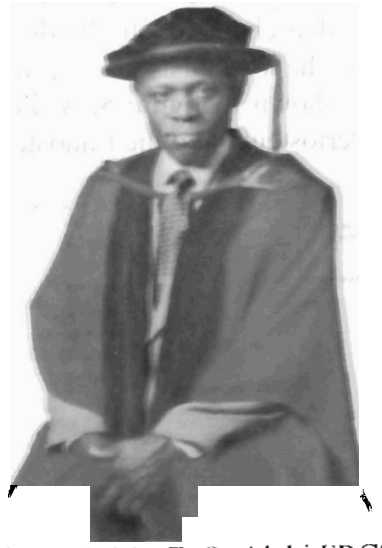


Figure 4: Mr. Z. O. Alabi FRCS

THE HUMAN BONE

Mr. Vice Chancellor, Sir, the Orthopaedic Surgeon is commonly referred to as "The Bone Doctor". Some "lovingly refer to us as the Bone carpenter" for reasons you will see in a few minutes during the delivery of this lecture. At the same time, significant number of people are beginning to appreciate the amount of engineering tools and techniques that we apply in our day to day

practice. The work of the Orthopaedic Surgeon also extends to other tissues because the bone is wrapped by a soft tissue envelop.

BONE

Bone, and the struts and levers which it forms, is exquisitely adapted to resist stress with suitable resilience, support the body and provide leverage for movement. It is a highly vascular mineralized connective tissue, consisting of cells and an intercellular matrix in which the great majority of its cells are embedded. The matrix is composed in part (40% dry weight in mature bone) of organic materials, which are mainly collagen fibres, and the rest consists of inorganic salts rich in calcium and phosphate. The bone tissue (osseous tissue) differs greatly from other tissues in the body. The bone is hard and many of its functions depend on that characteristic hardness. The bone is also dynamic in that its shape adjusts to accommodate stresses. A typical long bone is shown in figure 5, while figure 6 shows the dispositions of the Periosteum and the Endosteum layers.

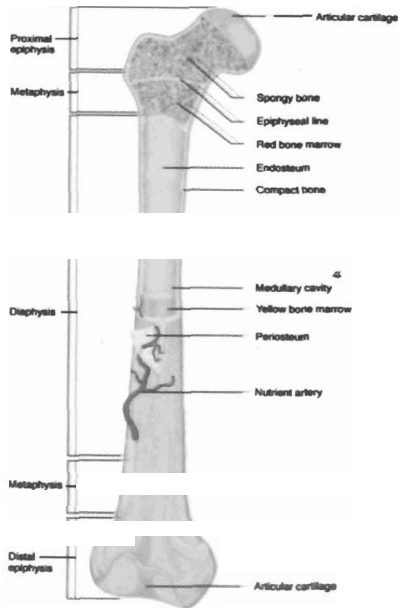


Figure 5. Anatomy of a Long Bone. A typical long bone showing the gross anatomical characteristics of bone.

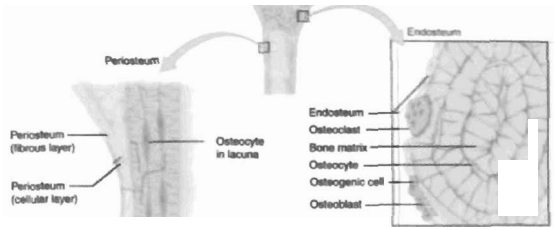


Figure 6. Periosteum and Endosteum. The periosteum forms the outer surface of bone while the endosteum lines the medullary cavity.

Bone Cells and Tissue

The bone contains a relatively small number of cells entrenched in a matrix of collagen fibers that provide a surface for inorganic salt crystals to adhere. These salt crystals form when calcium phosphate and calcium carbonate combine to create hydroxyapatite, which incorporates other inorganic salts like magnesium hydroxide, fluoride, and sulfate as it crystallizes, or calcifies, on the collagen fibers. The hydroxyapatite crystals give bones their hardness and strength, while the collagen fibers give them flexibility so that they are not brittle.

Although bone cells compose a small amount of the bone volume, they are crucial to the function of bones. Four types of cells are found within bone tissue: osteoblasts, osteocytes, osteogenic cells, and osteoclasts (Figure 7).

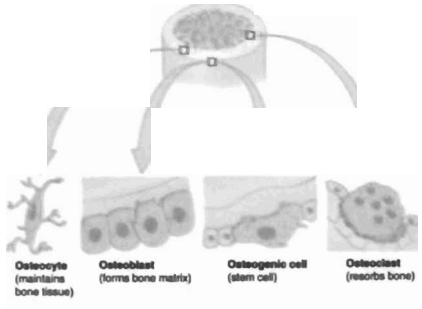


Figure 7. Bone Cells.

Osteogenic cells are undifferentiated and develop into osteoblasts. When osteoblasts get trapped within the calcified matrix, their structure and function changes, and they become osteocytes. Osteoclasts develop from monocytes and macrophages and differ in appearance from other bone cells.

The osteoblast is the bone cell responsible for forming new bone and is found in the growing portions of bone, including the periosteum and endosteum. Osteoblasts, which do not divide, synthesize and secrete the collagen matrix and calcium salts. As the secreted matrix surrounding the osteoblast calcifies, the osteoblast become trapped within it; as a result, it changes in structure and becomes an osteocyte, the primary cell of mature bone and the most common type of bone cell. Each osteocyte is located in a space called a lacuna and is surrounded by bone tissue. Osteocytes maintain the mineral concentration of the matrix via the secretion of enzymes. Like osteoblasts, osteocytes lack mitotic activity. They can communicate with each other and receive nutrients via long cytoplasmic processes that extend through canaliculi, channels within the bone matrix.

If osteoblasts and osteocytes are incapable of mitosis, then how are they replenished when old ones die? The answer lies in the properties of a third category of bone cells—the osteogenic cell. These osteogenic cells are undifferentiated with high mitotic activity and they are the only bone cells that divide. Immature osteogenic cells are found in the deep layers of the periosteum and the marrow. They differentiate and develop into osteoblasts. The dynamic nature of the bone means that new tissue is constantly formed, and old, injured, or unnecessary bone is dissolved for repair or for calcium release. The cell responsible for bone resorption, or breakdown, is the osteoclast. They are found on bone surfaces, are multinucleated, and originate from monocytes and macrophages, two types of white blood cells, not from osteogenic cells. Osteoclasts are continually breaking down old bone while osteoblasts are continually forming new bone. The ongoing

balance between osteoblasts and osteoclasts is responsible for the constant but subtle reshaping of the bone.

Bone composition.

The bone is made up of a collagenous matrix impregnated by mineral salts and populated by cells. This matrix is mainly of type 1 collagen lying in a mucopolysaccharide ground substance. Other non-collagenous proteins in small amounts are found.

Bone structure

Immature bone, found during the early stages of bone healing, possesses a haphazard arrangement of collagen fibres and cells, and is only a temporary bridge. Mature bone is well organized, with parallel layers of collagen sheaths or laminae and cells lying between them. They are called lamellar bone.

Bone modelling and remodelling

The bone is one tissue that grows throughout life. New bone can either be formed by ossification of proliferating cartilage (endochondral ossification) or direct ossification of connective tissue (membranous ossification).

Regulation of bone turnover and mineral exchange

Bone stores over 98% of the body's Calcium and 85% of Phosphorus, the balance being available as rapidly exchangeable fraction partly available in the extracellular fluid (ECF).

The human skeletal system functions

The skeleton serves six major functions;

1. Support. The skeleton (figure 8) supports the human frame and maintains its shape. The pelvis and its ligaments provide a floor for pelvic structures. Without the ribs, costal cartilages and intercostal muscles the heart would collapse.

2. Movements. The bones articulating at joints with the neuromuscular support helps in mobility. The ball and socket joints provide the greatest range of motion.

3. Storage. The bone matrix stores calcium and is involved in its metabolism. Bone marrow stores iron in ferritin useful in iron metabolism. The bone is not entirely calcium but a mixture of chondroitin sulphate and hydroxyapatite, the later constituting 70% of bone.

4. Blood cell production. The bone is the centre for blood production in the yellow bone marrow at the centre of the bone.

5. Protection. The skull protects the brain, eyes, middle ear. The ribs, sternum and vertebra protect the heart, lungs and great vessels. The vertebra protects the spinal cord while the ilium and spine protect the digestive and urogenital systems and the hips.

6. Endocrine function. The bone secretes a hormone called osteocalcin which is useful in glucose and fat metabolism.

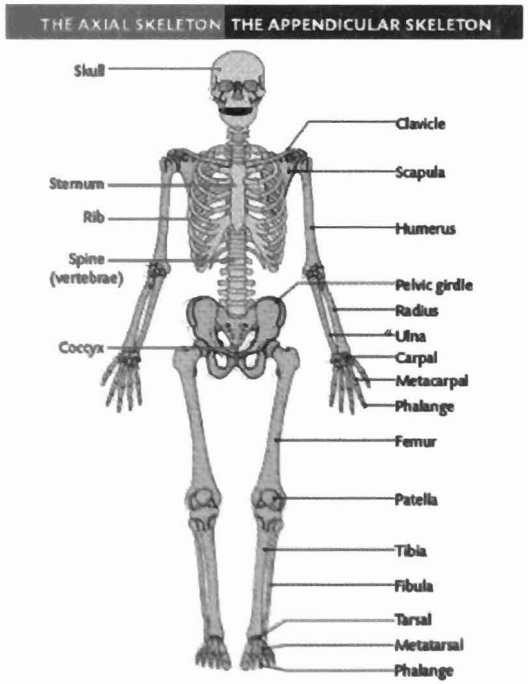


Figure 8. The axial and appendicular skeleton (Human Frame)

The human frame may be deranged (damaged), requiring **reconstruction** for any number of the reasons listed below:

COMMON PATHOLOGIES ASSOCIATED WITH THE HUMAN FRAME

They could be summarised into these groups: (Solomon et. al. 2001)

1. Congenital and developmental abnormalities
2. Infection and inflammation
3. Arthritis and rheumatic disorders
4. Metabolic and endocrine disorders
5. Tumours and lesions that mimic them
6. Sensory disturbance and muscle weakness
7. Injury and mechanical derangement.

Mr. Vice Chancellor Sir, my work/focus has been on Congenital & developmental abnormalities, Infection & inflammation, Arthritis & rheumatic disorders, and Injury & mechanical derangement.

BONE INFECTIONS:

Bone infections are common causes of morbidity in this environment. Chronic osteomyelitis and post traumatic osteomyelitis are great disease burden to Orthopaedic patients (Ikem et al., 2001; Ikem et al., 2003; Ako-Nai & Ikem et al., 2006; Orimolade & Ikem et al., 2009). Late presentation was a common cause of post traumatic osteomyelitis in this environment (Ikem et al., 2001). Our publications have enunciated the common bacterial isolates and its antibiotic sensitivity pattern. More than one-half (55.1%) of the bacterial isolates obtained were Gram-negative rods. About 97.1% of the Gram-positive isolates were Staphylococci. The antibiotic susceptibility profile demonstrated multi-resistance to commonly used antibiotics. Measures to improve treatment outcome were also suggested. This includes the use of culture-guided therapy to reduce the incidence of antibiotic resistance (Ikem et al., 2003; Ako-Nai & Ikem et al., 2009; Ojo & Ikem et al., 2010).

Table 1: Distribution of bacterial species cultured from superficial swabs of open fracture wounds at presentation.

Bacterial species (n=68)	No. of bacterial species cultured from superficial swab at presentation (%)
Gram-positive cocci, aerobes (n=27, 39.7%)	
• *Staphylococcus aureus*	19 (27.7%)
• *Staphylococcus epidermidis*	07 (10.3%)
• *Streptococcus Spp.*	1 (1.5%)
Gram-positive rods, aerobes (n=5, 7.3%)	
• *Corynebacterium*	2 (2.9%)
• *Lactobacillus Spp.*	3 (4.4%)
Gram-negative rods, aerobes (n=28, 41.4%)	
• *E. Coli*	9 (13.2%)
• *Salmonella spp.*	6 (8.8%)
• *Citrobacter*	3 (4.4%)
• *Pseudomonas aeruginosa*	4 (5.9%)
• *Proteus mirabilis*	3 (4.4%)
• *Klebsiella Spp.*	3 (4.4%)
Gram-positive rods (n=1, 1.5%)	
• *Clostridium perfringens*	1 (1.5%)
Gram-positive bacilli (n=7, 10.4%)	
• *Bacteroides fragilis*	7 (10.4%)

A comparison of the bacterial presence in the deep tissue biopsy versus superficial wound swab in open fractures has been prospectively analysed (Ako-Nai & Ikem et al., 2006; Ojo & Ikem et al., 2010). This is to assist clinicians in the management of these cases, with the aim of reducing the period of hospitalisation and cost to patients. The bacterial species cultured from superficial and deep-wound swabs and biopsies were similar.

A Comparison of Chronic Osteomyelitis in Sickle Cell Disease and Non-Sickle Cell Disease patients showed that bone pain, upper limb involvement and leucocytosis are more common manifestations of chronic osteomyelitis in Sickle Cell Disease patients than in the non-Sickle Cell Disease patients. Staphylococcus aureus remains the most common pathogen of chronic osteomyelitis in both groups in our environment. While gram negative organisms are prominent aetiologic factors; Salmonella organisms were not cultured in any of the patients. Hence, antibiotics effective against Staphylococcus aureus and gram negative organism should be prescribed (Orimolade & Ikem et al., 2009).

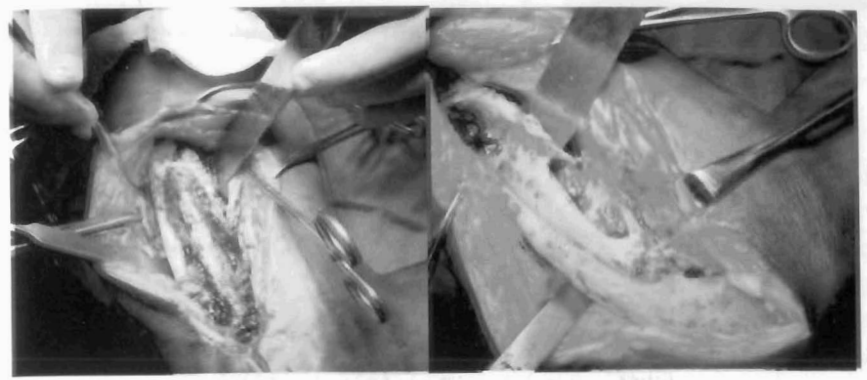


Figure 9: Sequestrum (Dead Bone) showing typical Bone-in-bone appearance. Intra Operative dead bone exposed.

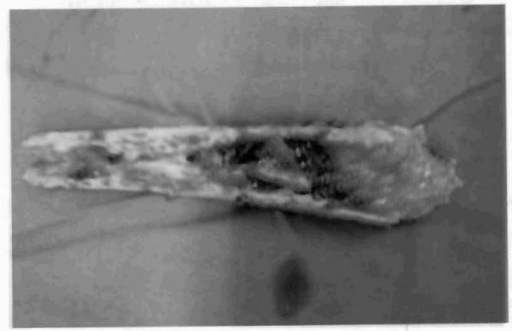


Figure 10: Sequestrum (dead bone) completely removed. This is part of the operative treatment for Chronic Osteomylities.

To enable the removal of the sequestrum (dead bone), the bone is opened by creating a vent. The disease process weakens the infected bone considerably. The cavity left behind is filled with bone cement impregnated with antibiotics.

Figure 11: Radiograph showing sequestrum of the entire diaphysis of the humerus. It is common in Sickle Cell Disease to have this type of extensive disease process.

Tuberculosis (TB) is a mycobacterium infection that affects most system including the bones. It is also a cause of chronic bone infection. Earlier in my career, my interest was drawn to the problem of back pain particularly in the young. This informed the study of TB spine. Clinical presentation, management and outcome of Spinal tuberculosis were studied (Ikem et al., 2001). Young patients were the most afflicted and backache was the commonest presentation. In tuberculosis endemic areas, symptom of back pain especially in the younger age group should be thoroughly investigated as this group constituted the largest affected population. The usefulness of Erythrocytes Sedimentation Rate (ESR) and directly observed therapy (DOT) in the treatment of spinal tuberculosis was well enunciated (Ikem et al., 2001).

DIABETIC FOOT:

What is the relationship between diabetes and the Orthopaedic Surgeon?

Diabetic Foot Ulcer and Infection.

Diabetic foot ulcer disease is the 2nd commonest cause of loss of limb in our environment (Ikem & Ikem et al., 2002). We have been able to evaluate diabetic foot enunciating and characterising the bacterial isolates and its antibiotic sensitivity pattern. The common precipitating factors and preventive measures especially education have also been identified. The epidemiology and precipitating factors have been determined (Ikem & Ikem et al., 2002; Ako-Nai & Ikem et al., 2006). Our various studies have shown that very useful investigations can be carried out on the patients by the attending physician in the clinics or the wards. This will reduce cost to patient and increase the speed of investigation with the overall advantage of improved quality of patient care (Ikem & Ikem 2009, Ikem & Ikem et al 2010).

We carried out a very comprehensive study using four different specimens to determine the presence of bacteria in diabetic foot ulcers. Superficial wound swab and deep wound biopsy were obtained. Specimens were aerobically and anaerobically cultured and studied by conventional bacteriological analysis and enzymatic (protease, lipase, DNAse and RNAse) methods. Sensitivity of isolates was conducted using a standard technique (Ako-Nai & Ikem et al., 2006). Aerobes constituted 90.7% of bacterial isolates of which Gram-negative rods accounted for 57.9%. Escherichia coli was the single most predominant organism (15.1%). Aerobic Gram-positive bacteria accounted for 32.8%. Staphylococcus aureus predominated (13.2%) followed by Coagulase-negative staphylococci (CONS) (9.2%) Streptococcus spp. and Corynebacterium spp. 5.2% each. Proteus species contributed (32.9%) of Gram-negative aerobes and Pseudomonas aeruginosa (12.5%). Eight (8.3%) of the Gram-negative rods were anaerobes.

Diabetic foot ulcer is one of the many complications of diabetes worldwide. Patients with diabetic foot ulcer disease should be

diagnosed early to be able to benefit maximally from the various treatment modalities available. This will enhance a significant reduction in the duration of hospitalisation and limb loss among these group of patients. Our study demonstrated that by using Semmes-Weinstein monofilament (figure 12 & table 2) for screening, a significant number of diabetic patients at risk of foot ulceration were identified (Ikem & Ikem 2009). This investigation was done in the clinic setting therefore reducing cost and saving time for both the patient and the attending physician.

Table 2: Association between the history of peripheral neuropathy and impaired sensory modalities tested.

Sensory modality		History of peripheral neuropathy		Significance
		Present	Absent	
Light touch	Intact	63	12	p=0.106
	Impaired	30	12	
Vibration sense	Intact	66	15	pNS
	Impaired	27	9	
Joint position sense	Intact	90	18	p<<0.001
	Impaired	3	6	
Monofilament test	Intact	72	18	χ^2=0.063
	Impaired	21	6	df=1
				p=0.802

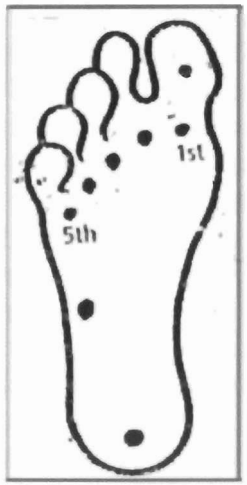
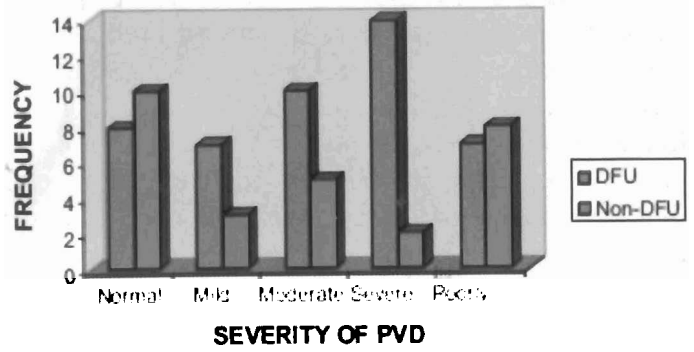


Figure 12: Sites used for monofilament testing.

Ischeamic foot in DM

Peripheral vascular disease is a chronic limb ischaemia seen in diabetic patient and is a risk factor for developing diabetic foot ulceration. Color Doppler Ultra Sound is used to evaluate vascular caliber and sufficiency. This is only available in a few University Teaching Hospitals in Nigeria including Obafemi Awolowo University Teaching Hospital. We have been able to demonstrate that with the use of handheld Doppler, a significant assessment of vascular insufficiency can be made in the clinic or in the ward by the attending physician (Ikem & Ikem et al 2010). This work was presented at an international conference on Diabetic Limb Salvage Washington DC, USA. It was well received and it stimulated very interesting discussions. This is now done routinely for all diabetic patients to enhance the quality of investigations and care. A total of 74 patients were recruited from the clinic and medical wards. Males were 42 (56.8%) and females were 32 (43.2%). Ratio of 1.3–1. The mean±SD age of the patients were 61.89±10.66 years and mean±SD duration of diabetes was 7.61±7.57 years. Forty-six (62.2%) presented with Diabetic Foot Ulcer (DFU) while 28 (37.8%) were non-DFU. The clinical parameters of patients with diabetic foot ulcer and those without are shown in Table 1. Risk factors for foot ulceration are common in our patients. The use of handheld Doppler Ultrasonography for measurement of ankle-brachial pressure index (ABPI) is a simple non-invasive way to evaluate peripheral vascular disease in diabetic foot patients. Also it aids the diagnosis of 'critical limb ischeamia at risk of limb loss' and will help to prevent and reduce the high rate of limb loss (amputation) in our patients.



Key:
Normal: Normal
Mild: Mild Obstruction
Moderate: Moderate Obstruction
Severe: Severe Obstruction
Poorly: Poorly compressible

Figure 13: Grading of PVD using ABI, Normal, normal; Mild, mild obstruction: Moderate, moderate obstruction: Severe, severe obstruction; Poorly, poorly compressible.

Figure 14: Ikem & Ikem at the Diabetic Limb Salvage Conference Washington DC.

Hand syndromes & DM

Limited joint mobility (LJM) of the hand also known as diabetic cheiroarthropathy or stiff hand syndrome is one of the many

complications seen in diabetic patients. Limited joint mobility is a painless and non-disabling complication of diabetes caused by thickening and stiffness of periarticular connective tissue. It involves mainly the small joints of the hand and is often neglected until hand deformity is severe enough to interfere with daily life. It tends to begin in the fifth digits and extends radially. Limited joint mobility was graded following the criteria of Silverstein et al:

Stage I: No limitation and equivocal or unilateral findings

Stage II: Involvement of one or two proximal interphalangeal joints, one large joint or only the metacarpophalangeal joints bilaterally

Stage III: Involvement of three or more proximal interphalangeal joints or one finger joint and one large joint bilaterally

Stage IV: Obvious hand deformity at rest or associated cervical spine involvement.

The prayer sign is described as the inability to fully flatten the two palms when opposed and clasped together. The flattening sign is described as the inability to fully flatten the palm on a flat surface.

Our study on assessment of limited joint mobility of the hand in black Africans with diabetes mellitus and in non-diabetics using a composite staging criteria established that black African with type 2 diabetes mellitus only have moderately severe cases of limited joint mobility. Limited joint mobility Stage II with 18.4% prevalence was the commonest followed by stage III with 7.9% prevalence among diabetic mellitus patients (Ikem & Ikem et al., 2009).

Limited joint mobility (stages I-III) were observed in patients with DM. There was no stage IV seen in both groups. Stage I LMJ (being no limitation) was seen in 56 (73.7%) patients with DM 60 (90.2%) controls. Stage II was seen in 14 (18.4%) patients with DM compared with 3 (4.8%) controls. Stage III was seen in only 6 (7.9%) patients with DM and no control had this stage.

This study has thus confirmed the involvement of LJM in Type 2 diabetes as seen in other works. It also showed the association of LJM with poor glucose control and the presence of diabetic

nephropathy. Hence, the presence of LJM in clinical practice performed by passive manipulations can serve as an indicator of suboptimal glycaemic control and long-term complications like diabetic nephropathy in patients. Despite this observation, LJM should not be a substitute for other appropriate evaluation of other long-term complications of DM.

Table 3: Analysis of various stages of limited joint mobility

Stages	DM n (%)	Control n (%)	Test of significance
I	56 (73.7%)	60 (95.2%)	$X^2 = 12.146$
II	14 (18.4%)	3 (4.8%)	df = 2
III	6 (7.9%)	0 (0%)	$p = 0.002$
IV	0 (0%)	0 (0%)	
TOTAL	76 (100%)	63 (100%)	

Severe negative effects of diabetic foot ulcers on health related quality of life has been documented in western studies using quantitative and qualitative methods, whereas none has been documented for Nigeria. Our studies showed that patients with diabetic foot ulcers had significantly poorer scores on domains of World Health Organization Quality-of-Life (WHOQol), particularly in physical, psychological, and overall quality of life had a higher health score. There was a relationship between clinical depression and negative effects of diabetic foot ulcer on health related quality of life. Depression adversely affects the QoL of patients with DFU. Intervention programmes to improve the QoL of patients with DFU need to incorporate early identification and treatment of depression. (Ola & Ikem et al., 2009).

We also, sonographically evaluated the prevalence of shoulder lesions in asymptomatic elderly subjects, both in the diabetics and in non-diabetics as controls (Uchendu & Ikem et al., 2015). The study was performed on 60 subjects with diabetes and 60 controls that were asymptomatic of shoulder joint disease. An ultrasound

examination of both shoulders was performed according to standard protocol. Of the 60 diabetic subjects, 32 were male and 28 were female, while there were 35 males and 25 females in the subject group. Supraspinatus (SST) tendon thickness was greater in diabetics than in controls, (6.44 ± 1.00 mm vs 5.25 ± 0.87 mm, P = 0.000) and (6.02 ± 0.90 mm vs 5.06 ± 0.81 mm, P = 0.000) in the dominant and non-dominant shoulders respectively. Biceps tendon (BT) thickness was also significantly greater in diabetics (4.16 ± 0.57 mm vs 3.20 ± 0.49 mm, P = 0.000), and (3.99 ± 0.48 mm vs 3.99 ± 0.48 mm, P = 0.000) in the dominant and non-dominant shoulders respectively. It was concluded that, there is an increase in the prevalence of asymptomatic shoulder pathology in diabetics that is aggravated by aging. Real-time ultrasound with its high sensitivity and specificity provides a well-tolerated, convenient and cost effective method of evaluating these shoulder lesions.

LONG BONE FRACTURES, ITS COMPLICATIONS AND RECONSTRUCTION OF THE HUMAN FRAME

Long bones are the commonest bones fractured in the body. They could be a source of great challenge for both the patient and the Orthopaedic Surgeon particularly when it is an open fracture (Ikem et al., 2001). This have been well enunciated in our article titled "Open fractures of the lower limb in Nigeria." The epidemiology, causative factors and common complications have been enunciated (Ikem et al., 2001; Ikem et al., 2006). The tibia bone is the commonest fractured bone. The majority of the tibial fractures occur in the distal third. In this area, the shaft is narrow and is bare of any muscle or tendon attachment. Closely related to the tibia is the fibula. The fibula is a very slender column of bone compared to the tibia. The head of the fibula articulates with the lateral condyle of the tibia proximally. The common peroneal nerve can be rolled against the fibula neck. It is vulnerable in this location to injury. Motor vehicular accidents (the bane of Nigerian roads) were the commonest cause of injuries. When there is open fracture, wound infection followed by delayed union are the commonest complications. Late presentation to the hospital was identified as an important factor among the patients with significant

complications (Ikem et al., 2006). The study "Determinants of management outcome in open tibia fractures" showed that the higher the Gustilo and Anderson grading of the open fractures of the tibia, the more severe the wound and bone infection that occurred. The interval between injury time and wound débridement time affected the treatment outcome (Ikem et al., 2006). Our contribution to knowledge of thè management of long bone fractures is now widely cited in several literatures worldwide. We have also been cited in the latest edition of a world acclaimed text book of Orthopaedics (Rockwood & Green's Fractures in Adults: 6th Edition page 398).

INTERLOCKING NAIL STUDIES

Our work "Achieving interlocking nails without using an image intensifier" (Ikem et al., 2007) published in the prestigious "International Orthopaedics" journal has been the most cited in Google Scholar to date using SIGN instrumentations and Nails. This work has also been cited in the book Skeletal Trauma: Basic Science, Management, and Reconstruction (Browner et. al ref: 223, page, 2442). The work showed that, with the aid of external jigs and slot finders, interlocking can be achieved without an image intensifier. These image intensifiers are very expensive and are not readily available in most low and middle income countries of the world, such as in the West African sub-regions, including Nigeria. In centres were image intensifiers are available such as OAUTHC, they are usually in limited numbers.

Interlocking nails for fracture stabilisation is usually done using image intensifier. However, the SIGN interlocking nails designed for use with or without image intensifier is able to give quality fracture care even in the absence of image intensifier. This has considerably reduced the intra- operative exposure of the patients to radiation (Ikem et al., 2007; Olasinde & Ikem et al., 2012). The locking screws are inserted with the aid of external jigs in the absence of image intensifier. The distal locking screws are particularly more difficult to locate even with the use of image intensifier. In view of our high success rate of locating the distal

locking screw using external jigs only, we have therefore, done a prospective study. The study determined the accuracy of locating the distal locking screws using external jig without the aid of intra-operative image intensifier. Distal screw insertion was successful (2 screws) in 93.3% and partial success (1 screw) in 6.7%. At first attempt 96.7% of distal screws were inserted while 3.3% distal screws were inserted at 2nd attempt (2nd visit to theatre). The study therefore concluded that external jig as a target arm is effective for the placement of distal locking screws (Ikem et al., 2011). Apart from fractures from vehicular accidents, it has also been used satisfactorily to treat patients with gunshot injuries. The main findings in this study showed that gunshot open fractures were predominately in young males affecting the lower limbs, infections were superficial with SIGN intramedullary nailing and union was achieved in all the patients. The SIGN intramedullary nailing provided an effective intramedullary nailing device in patients with gunshot fractures of the lower limbs with union of all the fractures and reduced complications (Olasinde & Ikem et al., 2012; Ogunlusi & Ikem et al., 2014).

This novel method of long bone fracture stabilisation has continued to inspire resident doctors to choose related topics for their exit dissertations of the National Postgraduate Medical College of Nigeria examination. Some of the dissertations supervised by me include the following: "**Interlocking nail versus External Fixator in the management of open tibia fractures**" (Esan 2010) and "**Antegrade versus Retrograde approach for femoral Interlocking nailing**" (Toluse 2013) among others. Comparison of unreamed interlocking nail and external fixation in open tibia shaft fracture management showed that the risk of wound infection was observed to be higher in this study with the use of external fixation in the management of open tibia fractures compared with unreamed interlocking intramedullary nail (Esan & Ikem et al., 2014). Antegrade Versus Retrograde Approach to Interlocking Nail Fixation of Femoral Diaphyseal Fractures: Is there Difference in Time to Union? showed that the retrograde approach compares favourably with antegrade approach for

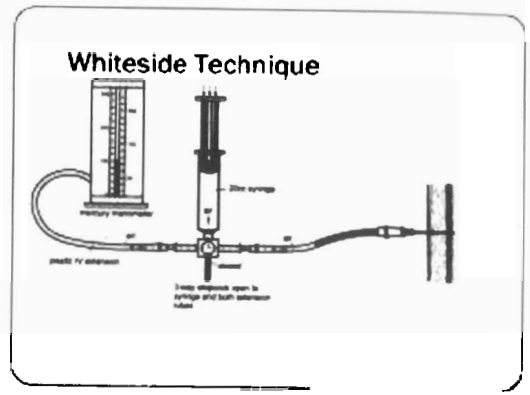
intramedullary interlocking nail fixation of diaphyseal femoral fracture in adults with respect to time of fracture healing (Toluse & Ikem et al., 2015). The study "Quadriceps strength and anterior knee pain following tibia intramedullary nailing: Clinical relationship" showed that anterior knee pain rate was 19.4% and there was no statistical association between the extensor strength and occurrence of anterior knee pain (Esan & Ikem et al., 2017).

COMPARTMENTAL PRESSURE STUDIES

Compartmental pressure is raised intra fascio osseous pressure within a defined compartment. The leg, four compartments could be raised following tibia and fibula fractures. It should be measured routinely in all patients with long bone fractures particularly affecting the tibia bone. Most centres simply use qualitative rather than quantitative methods of assessment for compartmental syndrome. This is usually not reliable and many cases of raised compartmental pressure may be missed. However, the reason is not far-fetched. It is expensive and the equipment for this measurement is not readily available in Nigeria.

LEG COMPARTMENTAL PRESSURE STUDIES

We have been able to demonstrate that compartmental pressure can be measured with simple and commonly available materials using Whitesides method. The apparatus required are inexpensive and easy to assemble (Ogunlusi & Ikem et al., 2005). I supervised this dissertation that was presented for the candidate's exit examination of the National Postgraduate Medical College of Nigeria examination. It was well received internationally. It was published in the prestigious International Orthopaedics "Compartmental pressure in adults with tibial fracture. International Orthopaedics (SICOT) (2005) 29: 130–133". This is creative, ingenious and resourceful. This study, enabled us to achieve standard results with common placed items. When the pressure was very high, and the differential pressure (i.e. the difference between the diastolic blood pressure and the intra-compartmental pressure) was greater than 30 mmHg, it was diagnostic of acute compartmental syndrome.



Whiteside Technique for measurement of compartmental pressure

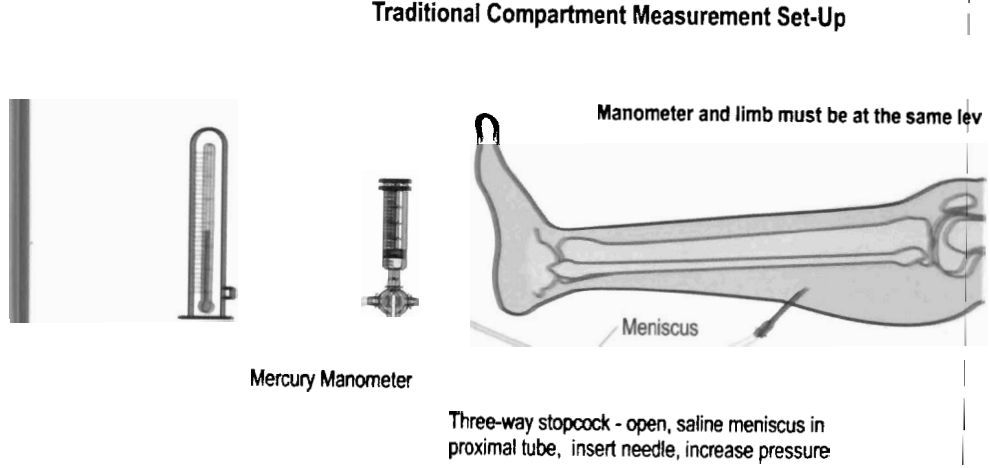


Figure 15: Compartment Pressure Measurement Set-Up

There are no studies on the range of normal compartmental pressures in Nigerians. Compartmental pressures in normal legs, as well as in patients with open tibia fractures and closed tibia fractures, for Nigeria was, determined using the Whitsides method. The study established that the anterior compartment pressures ranged from 3 mmHg to 18 mmHg whereas the deep posterior compartment ranged from 3 mmHg to 14 mmHg (Ogunlusi & Ikem et al., 2005). This could be of tremendous benefit to

clinicians in pre-empting compartmental syndrome among patients. Compartmental syndrome is a fracture complication with deleterious consequence such as Volkmans ischaemic contracture, and gangrene leading to loss of limb. With these studies, compartmental syndrome can be prevented using quantitative assessment rather than qualitative assessment. Qualitative assessment is objective, more reliable and more acceptable to the scientific community.

FOREARM COMPARTMENTAL PRESSURE STUDIES

The forearm is prone to raised compartment pressure and it is the second most common site for compartment syndrome. The normal compartment pressure of the forearm should be known and serve as a benchmark for the diagnosis of acute and chronic compartment syndrome. We studied normal compartment pressures of the forearm using a digital compartment pressure monitor "Assessment of normal forearm compartment pressures in a Nigerian population. European Journal of Trauma and Emergency Surgery. 2018 Apr 1;44(2):231-4.". The pressures in the volar compartment of the forearm ranged from 1 to 8 mmHg with a mean ± SD compartment pressure of 4.7 ± 1.5 mmHg. In the dorsal compartment the pressure ranged from 2 to 8 mmHg with a mean ± SD of 4.9 ± 1.7 mmHg SD, while the lateral compartment measurement ranged between 1 and 5 mmHg with a mean ± SD of 3.6 ± 1.1 mmHg. There was significant positive correlation ($p < 0.01$) between the compartment pressures in the volar, dorsal, and lateral compartments. The normal compartment pressure for forearm is 4.4 ± 1.6 mmHg and ranged from 1 to 8 mmHg from this study in our environment. This will serve as reference value when forearm compartment pressure is being measured (Adeyeye & Ikem et al., 2017). I supervised this dissertation that was presented for the candidate's exit examination of the National Postgraduate Medical College of Nigeria examination. It was well received internationally and it won the best prize in his exit examination.

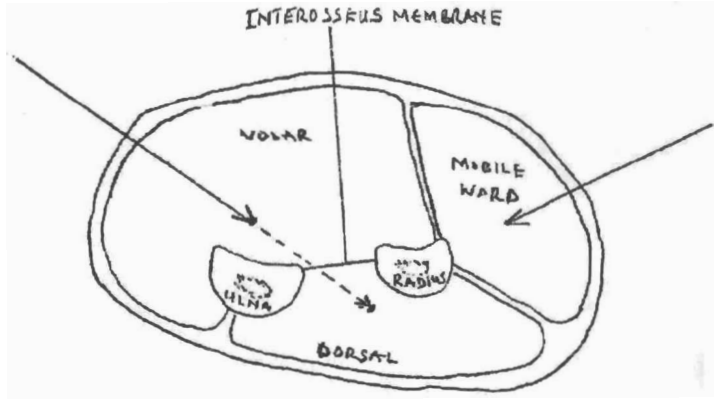


Figure 16: Cross section of the forearm and the needle positions

Table 4: Frequency distribution of compartment pressure in the fore-arm studies.

Compartment pressure (mmHg)	Volar compartment *n* (%)	Dorsal compartment *n* (%)	Lateral compartment *n* (%)
1	–		1 (3%)
2	2 (7%)	2 (7%)	3 (10%)
3	7 (23%)	4 (13%)	10 (33%)
4	1 (3%)	7 (23%)	8 (27%)
5	10 (33%)	8 (27%)	8 (27%)
6	7 (23%)	3 (10%)	
7	2 (7%)	3 (10%)	
8	1 (3%)	3 (10%)	–
Total	30 (100%)	30 (100%)	30 (100%)
Mean ± SD (mmHg)	4.7 ± 1.5	4.9 ± 1.7	3.6 ± 1.1

Ultrasonography Studies of Paediatric Long Bone Fractures

A prospective observational hospital based study was done to compare ultrasound assessment and plain radiograph assessment of paediatric fractures. A total of sixty-two patients between the ages of 1-15 years with a male to female ratio of 1.8:1 were recruited. Fifty-two fractures were diagnosed by plain radiographs and of these; fifty were recognised on ultrasound scans. Overall

sensitivity, specificity, positive and negative predictive values for ultrasonography were 96.2%, 100%, 100% and 83.3% respectively. Two false negative ultrasound scans were recorded and involved metaphyseal humeral fractures. Ultrasound scans were also noted to identify callus formation significantly earlier than plain radiographs. Ultrasound shows potential as a useful tool in diagnosis of paediatric fractures but may be limited in fractures around metaphyseal areas of bone where both false negative sonograms occurred in this study. Due to the ability to detect callus formation much earlier, ultrasonography may be very useful in monitoring of fracture healing which will aid decision making in fracture management. (Akinmade & Ikem et. al. 2018). I supervised this dissertation that was presented for the candidate's exit examination of the National Postgraduate Medical College of Nigeria examination. It was well received internationally. It was published in the prestigious International Orthopaedics.

FIGURE 17: DAY 1 SUPRACONDYLAR HUMERAL FRACTURE

ARROW SHOWS FRACTURE LINE

FIGURE 18: DAY 1 SUPACONDYLAR HUMERAL FRACTURE

LINE ARROW SHOWS SURROUNDING HAEMATOMA.

SOLID ARROW SHOWS DISPLACED FRACTURE LINE

FIGURE 19: WEEK 6 IMAGESHOWS HEALED

SUPRACONDYLAR HUMERAL FRACTURE RADIOGRAPH

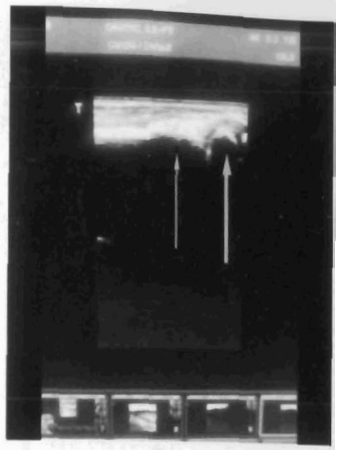


FIGURE 20: WEEK 6 HEALED SUPRACONDYLAR FRACTURE ULTRASOUND.

LINE ARROW SHOWS BRIDGING CALLUS SOLID ARROW SHOWS GROWTH PLATE

FRACTURES INVOLVING OTHER BONES REQUIRING RECONSTRUCTION

Reconstruction of Fractured Neck of Femur

Figure 21. Fracture neck of femur

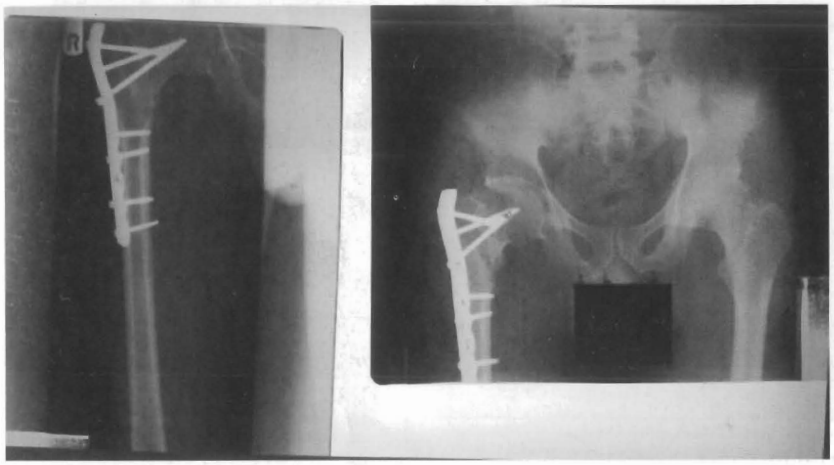


Figure 22. Reconstruction of Fractured Neck of Femur using proximal femoral locking plate.

Patient is a 40 year old farmer who was riding his motorcycle on a dirt road to the farm about 5 months ago. His motorcycle lost control and he fell on his right side. He immediately had pain and inability to bear weight on his right lower limb. He was managed at a Traditional Bone Setter for 2 months without improvement in condition. He had plain radiographs done and was then advised to present it to the hospital about 9 weeks post injury. A diagnosis of Right Per-Trochanteric fracture was made (Figure 21). He had Open Reduction and Internal Fixation with proximal Femoral locking plate 3 months ago (Figure 22).

Reconstruction of Fracture Tibia Plateau

Figure 23. Fracture of Tibia Plateau: Pre Op (A); Post Op reconstruction using T-Plate (B).

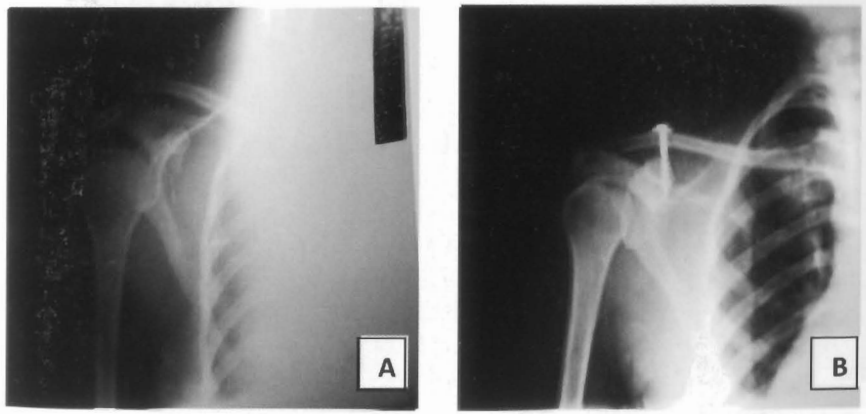


Figure 24: Patient with acromioclavicular separation from direct trauma (A); treated using screw and washer (B)

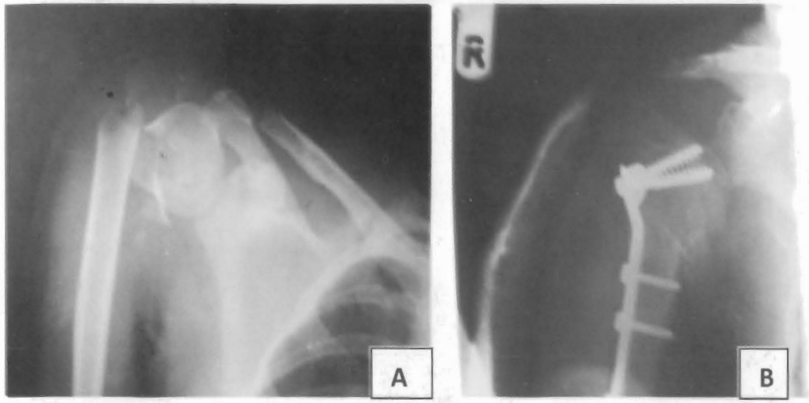


Figure 25. Severely communited fracture neck of Humerus (A) treated with cobra head plate (B)

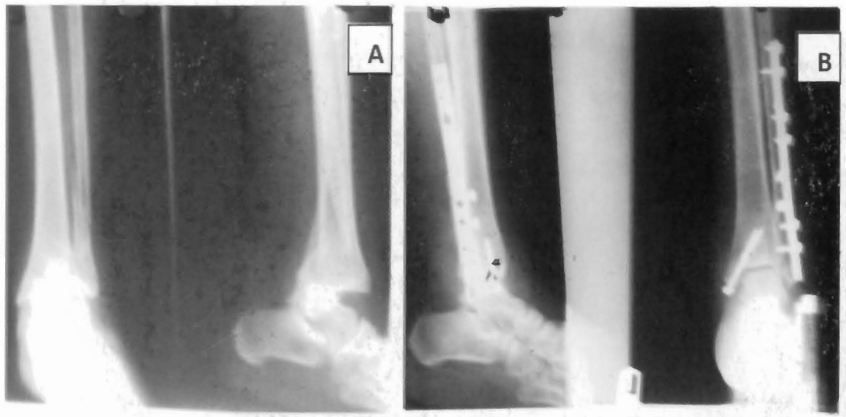


Figure 26. Ankle fracture Denis-weber C (A). The ankle fracture was treated using fibular plate and screws while the medial malleolar fracture was treated with malleolar screw

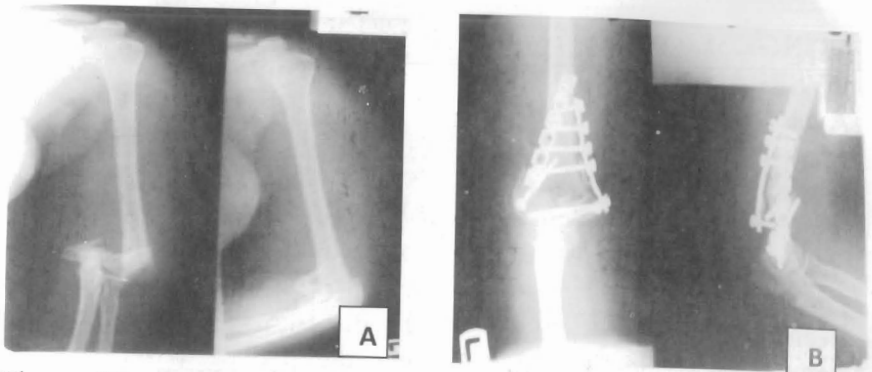


Figure 27. Complex communited humeral intercondylar fracture (A). Reconstruction of this complex communited fracture was done using reconstruction composite plates and screws (B).

Figure 28. Patient with diastasis of pubic symphysis being treated with External Fixator. Patient was able to walk around with the construct comfortably.

CONGENITAL ABNORMALITIES, DEVELOPMENTAL DYSPLASIA AND DEFORMITY CORRECTION

A case of bilateral congenital convex pes valgus was reported. This paper reports bilateral congenital convex pes valgus frequently termed vertical talus. A successful simple one-stage surgical reconstruction is described to enhance the understanding of the management of this rare complex deformity. Long follow up is emphasized because of a high incidence of recurrence. There has been a one-year follow up so far. Plantigrade and painless feet have been achieved which enables the patient to wear normal shoes. (Ikem et al., 2002).

Femoral bifurcation with ipsilateral tibia hemimelia: early outcome of ablation and prosthetic fitting. We presented a case report of a 2-year-old boy who was first presented to our orthopaedic clinic as a 12-day-old neonate, with a grossly deformed right lower limb from a combination of complete tibia hemimelia and ipsilateral femoral bifurcation. Excision of femoral exostosis, knee disarticulation and prosthetic fitting gives satisfactory early outcome. (Orimolade & Ikem et al., 2011)

A 14 year old girl presented with severe angular deformity of both knees. Her intercondylar distance pre-surgery was 70cm. When she first visited with us in the Orthopaedic clinic, she and her mother had two main concerns. They wanted her deformity corrected and wanted her to gain height like her peers at school. She was offered a one staged correction. At the end of her treatment, she added 3cm in height. Pre and Post correction photographs are showed below (Figures 29 and 30).

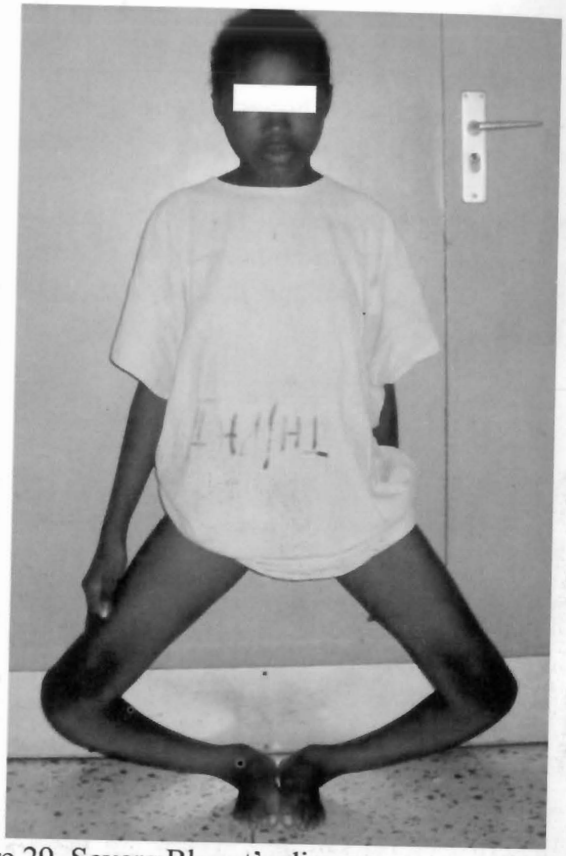


Figure 29. Severe Blount's disease pre-reconstruction

Figure 30. Severe Blount's disease post-reconstruction

A 14 year old girl presented with severe angular deformity of both knees. Her intercondylar distance pre-surgery was 60cm. When she first visited with us in the Orthopaedic clinic, her mother had one main concern. They wanted her deformity corrected because she was always bullied at school by her peers. She was getting into several fights at school because of being taunted by her peers. Her surgery had a satisfactory outcome. At the end of her treatment, she added 3cm in height. Pre and Post correction photographs are showed below.

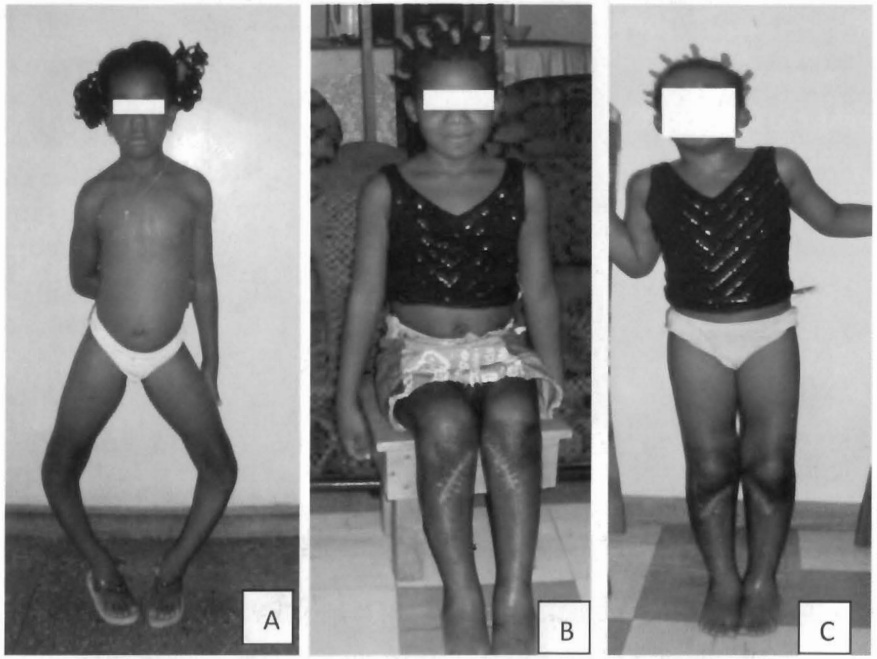


Figure 31. Severe Blount's disease pre-reconstruction (A) and post reconstruction (B and C)

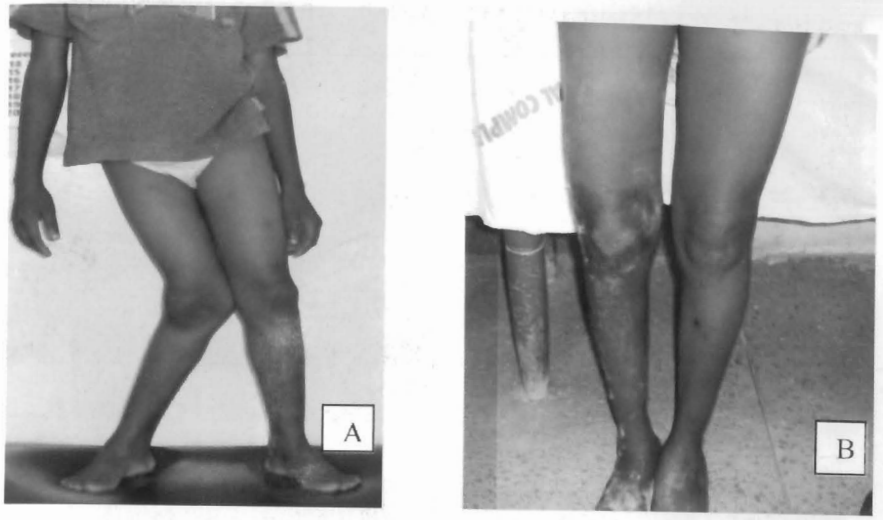


Figure 32. Idiopathic genu valgum. Pre reconstruction (A) and post reconstruction (B)

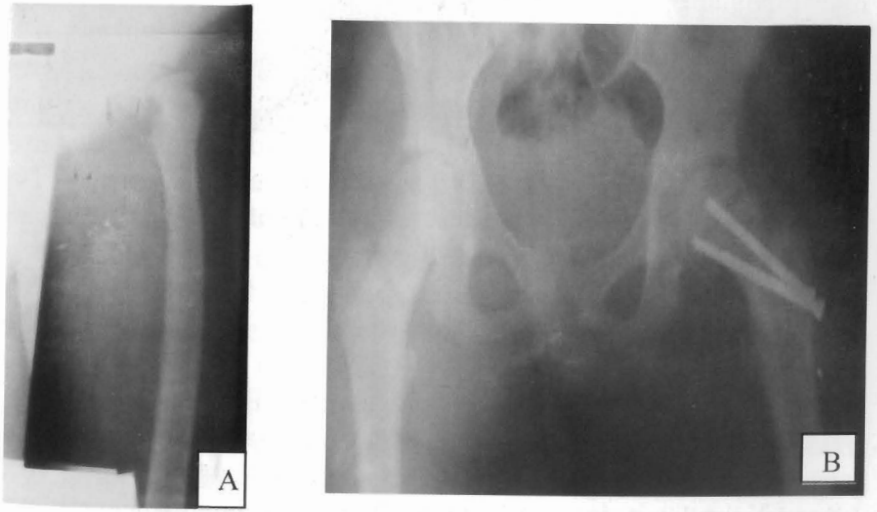


Figure 33. Slip Upper Femoral Epiphysis (SUFE) pre reduction (A) and post reduction and reconstruction (B)

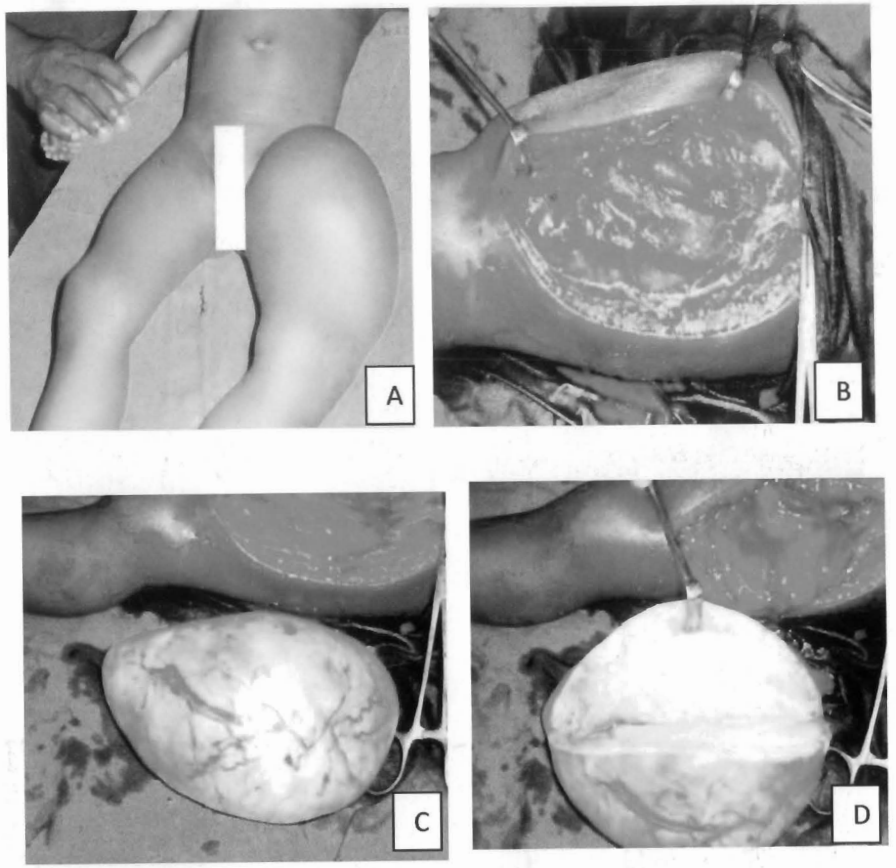


Figure 34: Massive thigh mass in an infant. Pre-operative (A); Intra operative (Huge Lipoma)
(B-D)

Mandibular reconstruction

I have also collaborated with colleagues in Dentistry through my research career. Reconstruction of Mandibular Defects caused by excision of massive mandibular Ameloblastoma using non-vascularised autogenous bone graft in Nigerians. Reconstruction with non-vascularised rib graft accounted for 68% of cases while iliac crest graft was used in 32% of the patients. Successful take of the grafts was recorded in 22 patients while three cases failed.

Wound dehiscence (two patients) and postoperative wound infection (eight patients) were the most common complications recorded. The ribs were harvested sub-periosteally ensuring that the cambium layer with capacity to regenerate is left behind. Indeed, there was evidence the ribs regrew. The use of non-vascularised graft is still relevant in the reconstruction of large mandibular defects caused by surgical ablation of benign conditions in Nigerians. Precise surgical planning and execution, extended antibiotic therapy, and meticulous postoperative care contributed to the good outcome (Ugboko & Ikem et al., 2007; Ndukwe & Ikem et al., 2014).

Pain assessment

Pain rating scales, such as the Visual Analogue Scale (VAS) and the Verbal Rating Scale (VRS) are important clinical tools for assessing patients' symptom status. For a non-English speaking patient, VRS could pose a problem as a result of language barrier. The objective of this study was to determine the intra-class and inter-class correlations of VAS and a Semantic Differential Scale (SDS) in patients with low back pain. Twenty-five patients with chronic low back pain were purposively selected for the study. Two testers (1 and 2) independently rated the pain experienced by the patients when asked to bend forward and hold on when pain was either exacerbated or aggravated. Finger-to-floor distance (FFD) was taken, as a measure of flexion of the spine, for each patient. Pain was rated using VAS and SDS. Our results showed strong intra-tester correlations between VAS and SDS of each tester ($p < .05$), and strong inter-tester correlations for VAS and for SDS ($p < .05$). The result of using two-way Analysis of variance (ANOVA) showed that there was no significant difference in pain ratings with VAS by tester-1, VAS by tester-2, SDS by tester-1, and SDS by tester-2. F-ratio was not significant ($p > .05$). There was no significant difference between FFDs by the two testers ($p > .05$). Our results suggest that the two scales are reliable and valid for clinical rating of low back pain. The pain rating scale produced from this study can now be used in clinics for non-English speaking patients. (Olaogun & Ikem et. al 2004).

Replacement Arthroplasty

Articular joint could become damaged by various disease processes. When the damage is very advanced and very painful causing incapacity, such a joint will require replacement.

Figure 35: Total Hip Replacement Arthroplasty in a patient SSCD

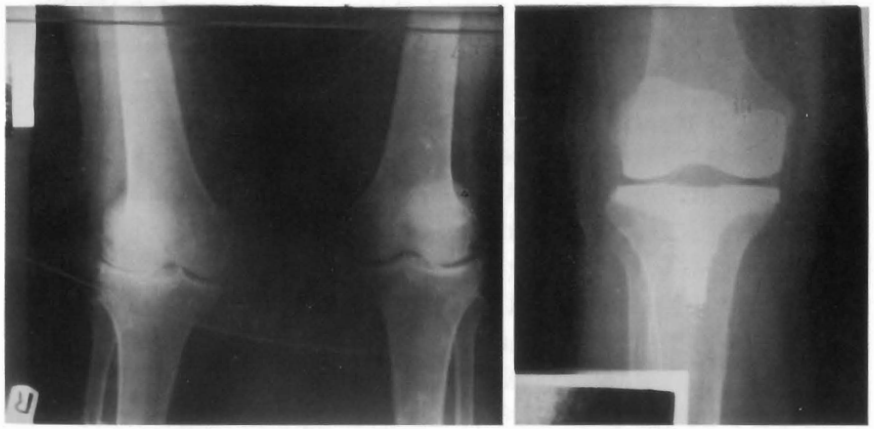


Figure 36: Total Knee Replacement Arthroplasty in a patient with severe OA

Figure 37: My travel fellowship to St. George University Teaching Hospital Székesfehérvár Hungary

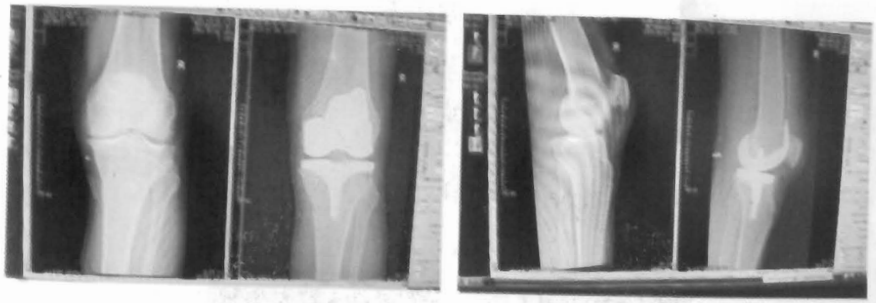


Figure 38: My hand-On experience in St. George University Teaching Hospital Székesfehérvár Hungary

PROFESSIONAL ACCOMPLISHMENT

I have a very good knowledge of interlocking nail fracture stabilisation technique. I have popularised this method of fracture stabilisation in Nigeria. During the Surgical Implant Generation Network (SIGN) conference in Richland Washington State USA, in 2005, I was formally trained in the use of SIGN interlocking system of fracture stabilisation.

I have played a pivotal role in the introduction of SIGN Interlocking nail system of fracture care in Nigeria. I have taught its usage to colleagues at various levels i.e. consultants, residents, nurses and medical students. I have popularised this method of fracture stabilisation by the use of Guest Lecture series in many institutions with topics such as "Achieving Interlocking skeletal stabilisation without the use of image intensifier" and "the value of interlocking nail in long bone fractures". Also, I have organised elaborate hands-on-workshops using saw dust bones and live surgeries demonstrations in many university teaching hospitals in Nigeria. These activities have enabled many orthopaedic surgeons acquire enhanced knowledge and skills.

Figure 39: LEWIS G. ZIRKLE, M.D.
President & Founder SIGN

Through my contacts with Surgical Implant Generation Network (SIGN) Headquarters USA, I have also assisted these institutions in acquiring complete set of instrumentations of SIGN Interlocking nails. This is now regularly available for use by all those who wish to avail themselves of this novel opportunity. This includes all

doctors (residents and consultants) and patients free of charge. This activity has improved the quality of fracture care of long bones in our institutions. Some of the institutions that have benefited from the organised workshops on SIGN Interlocking nails usage include: OAUTHC Ile-Ife, Seventh Day Adventist Hospital Ile-Ife, University of Calabar Teaching Hospital, University of Ilorin Teaching Hospital and Bowen University Teaching Hospital. Ogbomoso. I have also assisted all these institutions including Lagos University Teaching Hospital to acquire complete set of SIGN interlocking instrumentation. This activity has demonstrably improved the quality of long bone fracture stabilization in these hospitals and also the quality of patient care comparable to what obtains in the developed countries.

TYPICAL SIGN TRAINING SESSION:

I usually interact with the hospital administration letting them know how I intend to organize the training program and the spectrum of staff that could serve as target audience. I usually give at least 4 sessions.

Session 1: Power Point Presentation.
Audience (Hospital Grand Round Forum including Orthopaedic Surgeons, General Surgeons, Resident Doctors, Family Physicians, Hospital Nurses, Theatre Nurses, Medical and Nursing Students as applicable)

Session 2: Saw Bone Demonstration.
Audience (Hospital Grand Round Forum including Orthopaedic Surgeons, General Surgeons, Resident Doctors, Family Physicians, Hospital Nurses, Theatre Nurses, Medical and Nursing Students)

Session 3: Hands-On-Live-Surgery Demonstration.
Audience (Theatre Personnel including Orthopaedic Surgeons, General Surgeons, Resident Doctors, Family Physicians, and Theatre Nurses)

Session 4: SIGN DATA Reporting.
Audience (SIGN Program Manager for the institution.

BEFORE INTERLOCKING NAILS

We usually managed fractures using the following modalities:
External splints such as POP, Scotch cast, External Fixator, skin and skeletal traction
Internal splints such as Rush nails, Kuntschner nails, plates and Plate & screws
Kuntschner is mainly for mid shaft fractures around the isthmus. It has very great limitation where the bone is expanded. It will then require anti rotation bar.
Use of Kuntscher Nail if not rigid would require Below Knee POP with anti-rotation bar

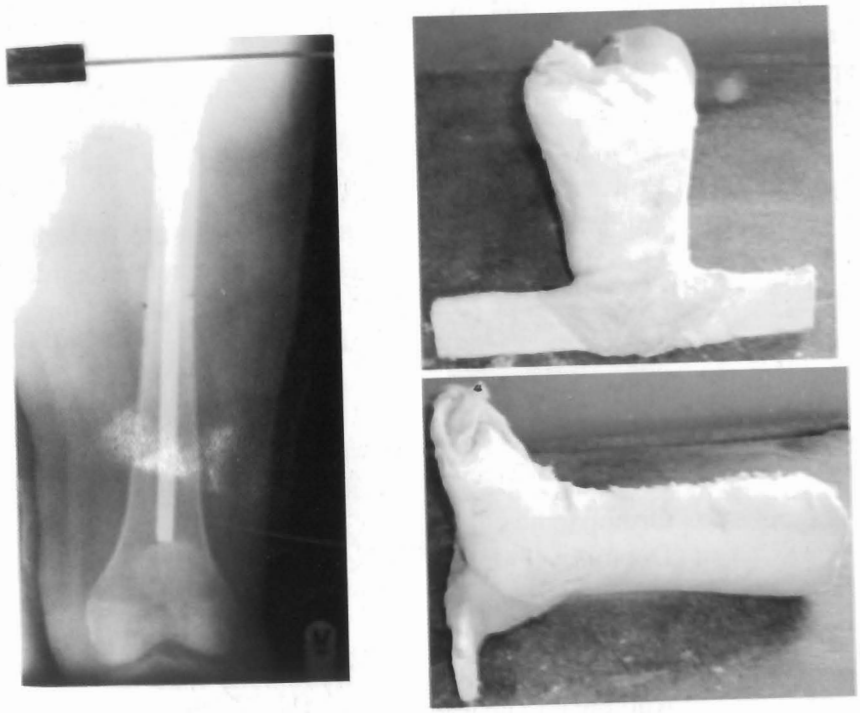


Figure 40: Kuntschner nail & Anti-rotation bar

Figure 41: Skeletal Traction versus SIGN Nail: Three Months versus Three Days

Figure 42: Typical Operating Room Session OAUTHC Ile-Ife

CRITICISMS HAVE ALWAYS BEEN OUR GREATEST ASSET.

We were often criticized for doing open reduction of fractures with all the emphasis on the drawback. This sparked in us the innovative ways of doing the same surgery in better ways. We subsequently became very skilful in doing closed methods of reduction and SIGN interlocking skeletal fixation.

In 2013, I was awarded the prestigious Orthopaedic Trauma Association (OTA) of North America Scholar. I was selected from among over 5,000 surgeons that competed. I gave a podium presentation at OTA 5th annual international forum October 9, 2013 Phoenix, Arizona, USA. Title: "CLOSED TIBIA INTERLOCK NAILING WITHOUT IMAGE INTENSIFIER"
The primary purpose was to demonstrate how to achieve **closed reduction** of tibia fractures without image intensifier.

TECHNIQUE
Fracture reductions and fixations were performed using SIGN interlocking nails and instrumentations. The closed reduction of the fracture fragments were achieved by careful and systematic palpation of surface anatomy of the tibia bone and without image intensifier.

With the limb on the table and leg held vertical. I usually prefer to flex the hip and knee joints maximally usually well over 110^0. In this position, tibia medullary canal is assessed easily without the risk of bending the reamers. I sometimes use the figure 4 position.
The way the bone awl is introduced is the key to staying within the medullary canal. I make sure it's tip is curved anterior maximally as it is being inserted. By palpating the anterior tibia crest, and the medial boarder, the fracture site can be felt. This lets me appreciate when closed reduction is achieved. Also as the reamers crosses the fracture site, I usually feel its vibratory motion. The gritty sound and feeling of reaming the distal fragment can also be appreciated. Sometimes, I have an assistant hold the patient's foot/ankle while I use my left thumb and middle fingers to stabilize the fragments at the fracture site as the reamers negotiate the fracture sites. If the tibia is short enough to allow the reamers touch the tibia plafond, it is also another indicator that the reamer is within the medullary cavity and reduction has been achieved. I reduce proximal and distal third fractures the same way.

However, distal third fractures are generally easier to reduce than proximal fractures. For proximal third fractures, I usually make

sure that the knee is maximally flexed. I have not required any blocking screw and I have not perforated the posterior tibia so far.

DISIMPLACTION TEST: To determine the correct insertion of the screws.

i. After the insertion of the first distal interlock screw, attempt to dislodge the nail by pulling the nail directly towards you. If the screw engaged the nail, it will not dislodge.
ii. After the insertion of the proximal interlock screw, attempt to rotate the foot with the knee stabilized. If the screw engaged the nail proximally, it will not rotate.

DIRECT RADIOGRAPY ESTIMATION TEST: To determine the actual screw length.
i. A plain radiograph, Anterior Posterior (AP), view of a long bone either tibia or femur is used. You place the screw close to the film to estimate the screw length. It is most useful in proximal femur were soft tissue may sometimes impinge on the depth gauge.
This innovative technique and presentation was well received.

TYPICAL PATIENT RADIOGRAPHIES

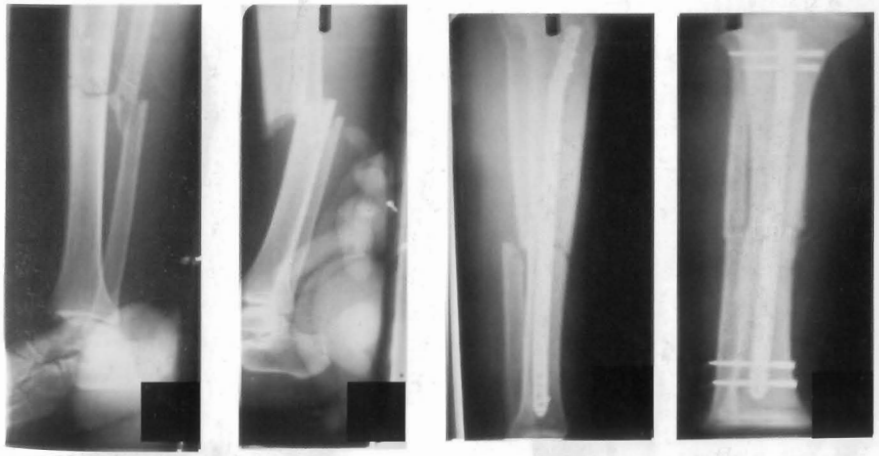


Figure 43. Pre op (A and B) and Post closed reduction and nailing (C and D) radiographs of transverse tibia fracture.

Figure 44: Leg position for nail insertion without exposing the fracture site

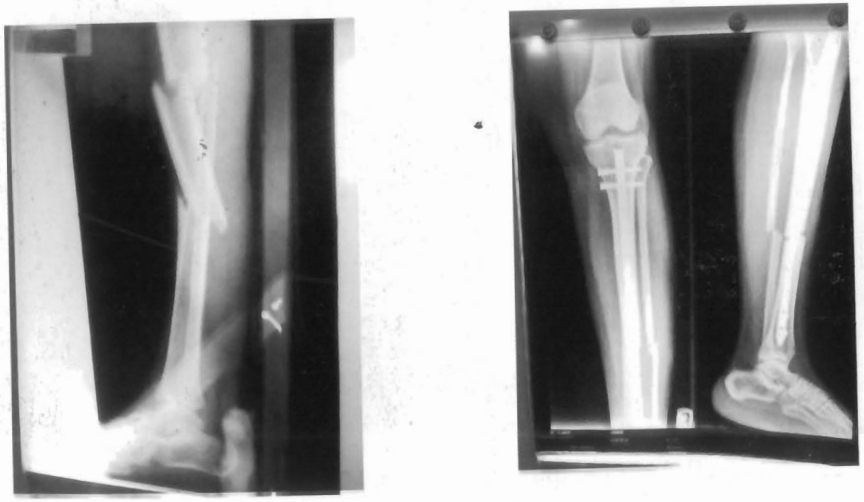


Figure 45: segmental fracture reduced closed

Figure 46: Severely communited fractures reduced closed

Severely communited fractures are also managed with the same technique of closed reduction and skeletal stabilized
With the aid of external gigs, slot finders and careful palpation, closed tibia interlock nailing can be achieved without image intensifier.

SUCCESSFUL CLOSED REDUCED FEMUR

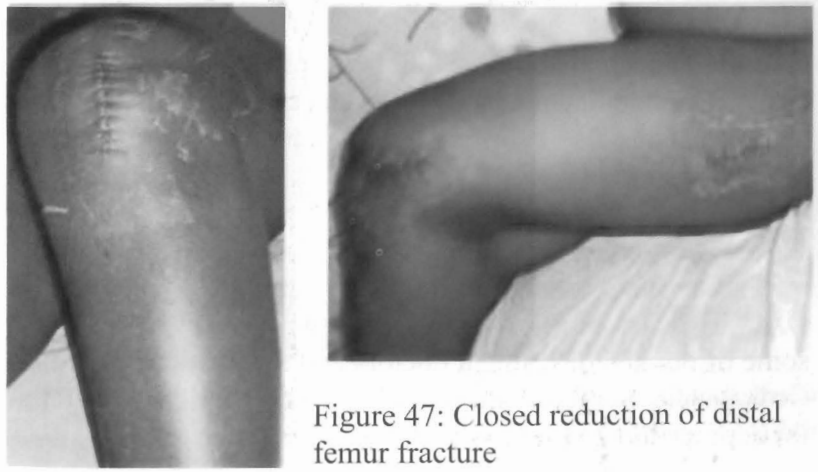


Figure 47: Closed reduction of distal femur fracture

We have also commenced closed reduction techniques for select distal femur fractures

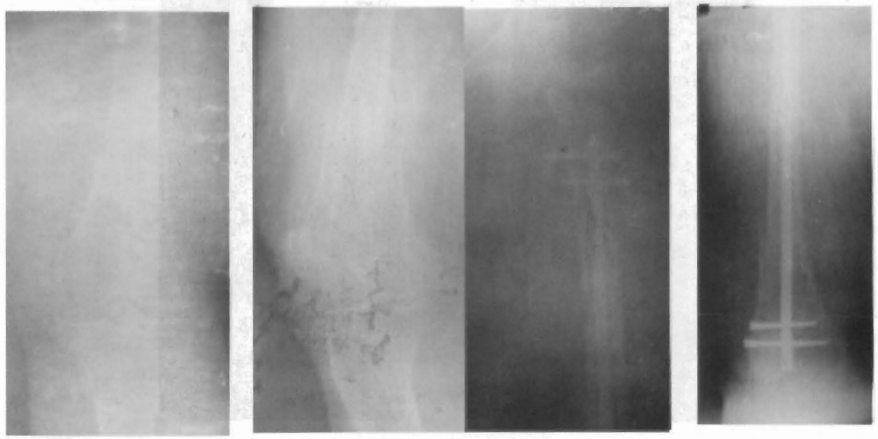


Figure 48: Closed reduction of distal femur fracture

Since 2005, I have been serving as the Program Manager for SIGN. Since then to date, they have continued to provide our Hospital Orthopaedic implants including SIGN instrumentations and Nails, as well as external fixators at no cost to our patients. This has reduced significantly the cost of treatment for those that qualify to benefit from the program.

I have facilitated some of our Resident Doctors and Consultants to visit SIGN headquarters for training directly by the organization. I have also facilitated their attendance and participation in a comprehensive flap course that assists tremendously with the care of open fracture injuries.

These very unique method of closed reduction without image intensifier have been popularised by me over time not just in OAUTHC but also throughout Nigeria. I have been able to teach some of our senior resident doctors and some interested consultant Orthopaedic Surgeons these skills. I am very glad that they do these procedures effortlessly with great passion.

Skills workshop:

I pioneered the establishment of a skills workshop located in Children Orthopaedic Ward Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) Ile-Ife. It was designed primarily to teach, transfer knowledge and skills to our young colleagues.

Figure 49: Training in session in the skills workshop for Resident Doctors in OAUTHC. Ife

Figure 50: Facilitating transfer of skills in an international conference from one generation to another generation - Dad to Daughter.

Figure 51: Serving as facilitator in an international conference

REORGANISATION OF THE DEPARTMENT OF ORTHOPAEDIC SURGERY AND TRAUMATOLOGY

The Department has been reorganized into the various sub-specialties based on the requirements for accreditations of both the National Postgraduate Medical College of Nigeria and West African College of Surgeons. The sub-specialties include:
Complex trauma,
Arthroplasty,
Arthroscopy,
Paediatric Orthopaedics,
Spine,
Orthopaedic Oncology.

LIST OF SOME SCHOLARSHIP & AWARDS:

i) Paediatrics Association of Nigeria Prize for the best Medical Student in Paediatrics. University of Jos 1982
ii) Prof. John Herzenberg prize for the construction of the Best Ilizarov frame during 2007 annual SIGN conference 2007
iii) Orthopaedic Trauma Association (OTA) recipient for 2013 OTA SCHOLAR AWARD 2013
iv) Distinction Hip and Knee Arthroplasty Fellowship in Hungary 2018

Some of the supervised dissertation that have been award winners at the exit Fellowship examinations or published in top rated International journals.

Dr. J.D. Ogunlusi. 2004. Compartmental pressure in closed tibial fractures in adults at the Wesley Guild hospital, Ilesa. Nigeria. This has been published in the prestigious International Orthopaedics Journal. "Ogunlusi, J.D., Oginni, L.M., **Ikem, I.C.,** (2005), Compartmental pressure in adults with tibial fracture. *International Orthopaedics*, 29: 130-133."

Dr Toluse A.M. 2013. Antegrade versus Retrograde approach for femoral Interlocking nailing. This won the prize for the best dissertation in the final fellowship examination in Faculty of Surgery of the National Postgraduate Medical College of Nigeria.

Dr Adeyeye A.I. 2014 Compartment pressure in closed forearm fractures. This won the best prize in the final fellowship examination in Faculty of Surgery of the National Postgraduate Medical College of Nigeria.

Dr Akinmade A. 2017 Ultrasonography in the diagnosis of paediatric long bone fracture. It is also a prize winner for the best candidate in the exit examinations and has been published in the prestigious International Orthopaedics.

"Akinmade, A., **Ikem, I.**, Ayoola, O., Orimolade, E., & Adeyeye, A. (2018). Comparing ultrasonography with plain radiography in the diagnosis of paediatric long-bone fractures. International orthopaedics, 1-11."

Dr Onuoha K. M. 2017 Management of Distal radial fractures: comparing haematoma block and conscious sedation. This won the best prize in the final fellowship examination in Faculty of Surgery of the National Postgraduate Medical College of Nigeria.

CONCLUSION

Mr. Vice Chancellor Sir, apart from the above mentioned contributions to knowledge, during the course of my career as an Orthopaedic Surgeon and Traumatologist, I have trained over 20 Consultant Orthopaedic Surgeons and Traumatologist. Significant number of them are well-positioned within the Nigerian health sector and all over the world. I have supervised over 25 dissertations. They include one Ph.D, five Masters, and 22 Final Fellowship Examinations for the National Postgraduate Medical College and the West African College of Surgeons.

I have been an examiner of both the Faculty of Orthopaedics and the Faculty of Surgery, National Postgraduate Medical College of Nigeria, and Faculty of Surgery, West African College of Surgeons. I have served as the foundation Secretary, Faculty of Orthopaedics, National Postgraduate Medical College of Nigeria. I have served the Nigerian Orthopaedic Association (NOA) at various times in different capacities such as Zonal 1: Treasurer, Secretary, and Chairman also, National Treasurer and Honorary Secretary, Nigerian Orthopaedic Association.

I am a member of International Society of Orthopaedic Surgery and Traumatology (SICOT), Member American Academy of Orthopaedic Surgeons and member of Orthopaedic Trauma Association of North America. I have presented several articles in notable international conferences. I am well published with over 60 original articles in reputable international and national journals.

Mr. Vice Chancellor Sir, the whole essence of my academic career of Orthopaedic Surgery and Traumatology has always been to reconstruct diseased and broken bones so that those whose lives are broken may have them back with joy and gratitude to GOD.

"Abundance flourishes in a grateful heart". I am grateful to my parents, siblings especially Anthony and Augustine, in-laws, friends, all my teachers through my medical school to my postgraduate education. I am very grateful to Emeritus Professor

A. A. Akinsola, the doyen of Nephrology in Nigeria. He has always been a great mentor to our family. I am grateful to all the members of the Department of Orthopaedic Surgery and Traumatology. It is the Department that gave me the base for my academic career in "Great Ife". The support of all the members of staff particularly towards the preparation for this inaugural lecture have been exceptional. I will like to thank the Management and Staff of SDA hospital Ile-Ife, for allowing me full access to their facilities. To my ECKANKAR family I say thank you so much. You all have stood by me and supported me throughout this journey. Special mention must be made of Nigerian National Postgraduate Medical College lead by the College President Professor Opubo Benedict da Lilly-Tariah. We have a very reliable family member and brother who has always stood by us in thick and thin like the proverbial rock of Gibraltar in the person of Associate Professor Bola Ola and his family (Doubara, Tolu & Morenike).

My darling wife, Rosemary of a couple of decades, a Professor in her own right, who was there when I started my medical education. She has always been encouraging and supporting my career even through very difficult terrain. (She often made seemingly hard nuts easy for me to crack). Thank you so much. To my loving children (Anwuli & Ugo), their spouses (Ikenna & Arinze) and adorable grand-children I say thank you.

RECOMMENDATIONS

1. Our roads and modes of transportation should be made safer. Okada riders should be properly taught how to ride before the commencement of commercial Okada riding. Okada riders should have basic first aid training to assist with pre hospital care Okada riders should be educated in basic road use and safety measures such as the use of helmet to protect their lives and that of the public at large. All transporters and road users should be better regulated.
2. Government should make treatment accessible and affordable to all its citizens.
3. We should all be reminded of the old good adage than:

"PREVENTION IS BETTER THAT CURE"

Mr. Vice Chancellor Sir, distinguished ladies and gentlemen, I thank you all for coming and listening.
May the Blessing Be!

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