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288 PIONNER COMPUTED TOMOGRAPHIC

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EXAMINATIONS IN UNIVERSITY OF UYO

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TEACHING HOSPITAL, UYO, NIGERIA.

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ABSTRACT

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BACKGROUND

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Computed tomography (CT) is a cross sectional imaging tool that has

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dramatically improved diagnosis. Its increasing availability was recently

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extended to University of Uyo teaching hospital (UUTH), Uyo, Nigeria.

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AIM

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Evaluating pioneer CT examinations in UUTH, Uyo.

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MATERIALS AND METHODS

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A retrospective study of all CT examinations conducted after the installation of

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the 16 slice Activion Toshiba, 2009 CT scanner. Period studied was from 4th

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November, 2012 to 9th August, 2013. Demographic data, clinical presentations,

19 type of examinations and positive radiological features were extracted from
20 records of all computed tomograms.

21 Results were analysed with SSPS 13 computer package.

22 RESULTS

23 288 Patients were studied but 281 with adequate demographic data were
24 analyzed. Of this number, 56.6% (n=159) were males and 43.4% (n=122)
25 were females giving M: F ratio of 1.3:1. The largest studied population in males
26 and females were 10.3% (n=29) in 50-59 age range and 8.2% (n=9) in 40-49
27 respectively.

28 The commonest examination 62.5% (n=180) was cranio-cerebral, followed by
29 abdomino-pelvic CT 3.5% (n=10). The commonest indication of cranio-cerebral
30 CT was trauma (20%) followed by cerebrovascular accident (CVA) 16.1%.
31 Normal brain CT were 18.3% (n=33), whereas unrelated CT brain findings
32 were 16.1% (n=29).

33 11.4% (n=33) of 288 patients who underwent CT were used for test-running
34 the machine (male to female ratio 1.12: 1) at no cost to the patient.

35 CONCLUSIONS

36 The commonest CT examinations in Uyo, Nigeria is cranio-cerbral with the
37 commonest indications being trauma and CVA.

38 **KEY WORDS**

39 Computed tomography, Cranio-cerebral, Trauma, Abdomen

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43 **INTRODUCTION**

44 Computed tomography (CT) is a cross-sectional imaging modality though
45 based on ionizing radiation but has obviated the problem of tissue
46 superimposition seen in conventional radiography. When conventional
47 radiography fails to resolve a clinical question, cross-sectional imaging with
48 ultrasonography, CT or magnetic resonance imaging (MRI) is often demanded
49 [1]. CT has salient peculiarities when compared to other cross-sectional
50 imaging. For example, operator dependency palpable in ultrasonography is
51 absent in CT as CT images are reproducible. Similarly CT has better cortical
52 bone definition unlike MRI. Volume rendered 3D CT has erased the
53 extensive streak artifact on conventional axial CT imaging and multi-planar
54 reconstructed images as well as susceptibility artifact on MRI bemoaning
55 patients with metal hardware [1].

56 CT advent in 1970 has since revolutionized diagnostic radiology [2]. It is
57 extensively regarded as among the most vital advances in medicine and its
58 integration into routine care has dramatically improved patient health care [3].
59 Its scope in ailment management cut across all specialities in medicine. In fact,
60 CT is a delight to Neurosurgeons and Neurologists. Use of CT for diagnostic
61 evaluation has increased tremendously over the past 2 decades [3]. The total
62 number of CT examinations performed annually in the United States has risen
63 from approximately 3 million in 1980 to nearly 70 million in 2007 [3]. Children
64 are not spared with about 4 million paediatric CTs done in United States [2].
65 Similar rapid increase in CT usage applies to other countries [2].

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67 The above noted sharp increase in CT usage has been driven largely by
68 advances in CT technology that make it extremely user-friendly, for both the
69 patient and the physician[2]. Such technology has led to new frontiers of
70 disease evaluations hitherto were non-existent. For example, virtual
71 colonoscopy and virtual bronchoscopy gave insight into the lumina of the
72 colon and bronchus respectively.

73 Despite new grounds in medicine exploited through CT, its perennial problem
74 is high radiation dose. By its nature, CT involves larger radiation doses than the
75 more common, conventional x-ray [2]. Though the risks for any one person are

not large but the increasing exposure to radiation in the population may be a public health issue in the future [2].

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80 **AIMS**

81 To evaluate computed tomographic examinations in University of Uyo teaching
82 hospital with respect to type of examinations, demography and positive findings

83 **SUBJECTS AND METHODS**

84 A retrospective study was carried out of all computed tomographic studies
85 performed in the Department of Radiology, University of Uyo teaching hospital,
86 Uyo, Akwa Ibom state, Nigeria. The span period started from the first day of
87 test-running the newly installed CT machine which was 4th November, 2012.
88 The period under review ended on 9th August, 2013. The CT scanner is
89 Toshiba Activion 16, Japan, a 16 slice helical CT manufactured in 2009.

90 All patients who received CT imaging were included in the study. There were
91 no other inclusion or exclusion criteria. Demographic information for each
92 patient, (date of examination, age and gender) as well as their reason for
93 obtaining CT imaging were extracted from duplicate copy of the formal
94 radiology reports for each patient from departmental records. CT scans were

95 classified based on the part of the body imaged like cranio-cerebral, abdomen,
96 chest et cetra et cetra.

97 Results were purely classified as normal with no pathological findings or CT
98 with pathological findings or CT with unrelated findings. The specifics of the
99 CT findings were beyond the scope of this study.

100 Results were analyzed with computer statistical package SSPS 13.

101 **RESULTS**

102 288 Patients were studied with adequate demographic data on 281 patients (See
103 table & graph 1). These 7 patients with incomplete demographic data were
104 excluded from analysis as they were recorded as adults or had no gender
105 documentation. Therefore 281 patients were analyzed. Of this number, 56.6%
106 (n=159) were males and 43.4% (n=122) were females giving Male: Female
107 ratio of 1.3:1. The largest male population studied was in the 50-59 age range
108 with 10.3% (n=29). In females, the largest studied population was in the 40-49
109 age range with 8.2% (n=9). The least studied population in both sexes was in
110 the 80-89 with 3 males and 2 females respectively.

111 The commonest examination was cranio-cerebral and there were 180 cases
112 (62.5%). This was followed by abdomino-pelvic CT 3.5% (n=10), chest 2.4%
113 (n=7), Spine 1.32% (n=4). Others were 33.7% (n=97) (See chart 1). In the
114 cranio-cerebral CT, 16.1% (n=29) were due to CVA, 20% (n=36) were due to

115 trauma, 4.4%(n=8) were due to headache and 3.3% (n=6) were due to space
 116 occupying lesions. Normal cranio-cerebral CT were 18.3% (n=33) whereas
 117 unrelated cranio-cerebral CT findings were 16.1% (n=29).

118 Out of the entire 288 studied patients, 11.4% (n=33) were used for test-running
 119 the machine with 1.12: 1 male to female ratio. These patients had clinical
 120 symptoms and were referred from various clinics in the hospital. The
 121 examinations were done at no cost to the patient.

122 TABLE 1 SHOWING AGE AND SEX DISTRIBUTIONS OF STUDIED
 123 POPULATION

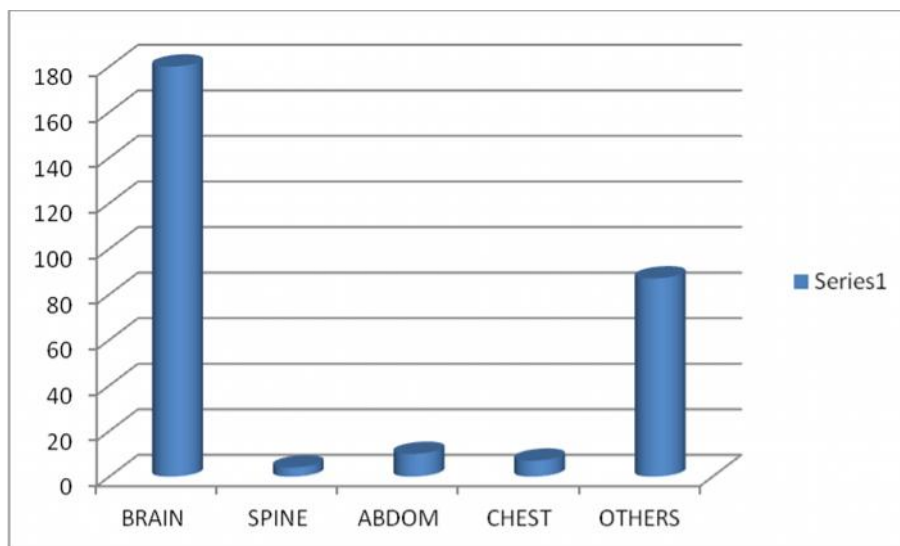
AGE RANGE	MALES	FEMALES
0-9	7	7
10-19	7	14
20-29	26	18
30-39	22	16
40-49	21	23
50-59	29	10
60-69	21	22

70-79	13	10
80-89	3	2
TOTAL	159	122

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126 CHART 1 SHOWING THE FREQUENCY OF DIFFERENT TYPES OF CT
127 EXAMINATIONS



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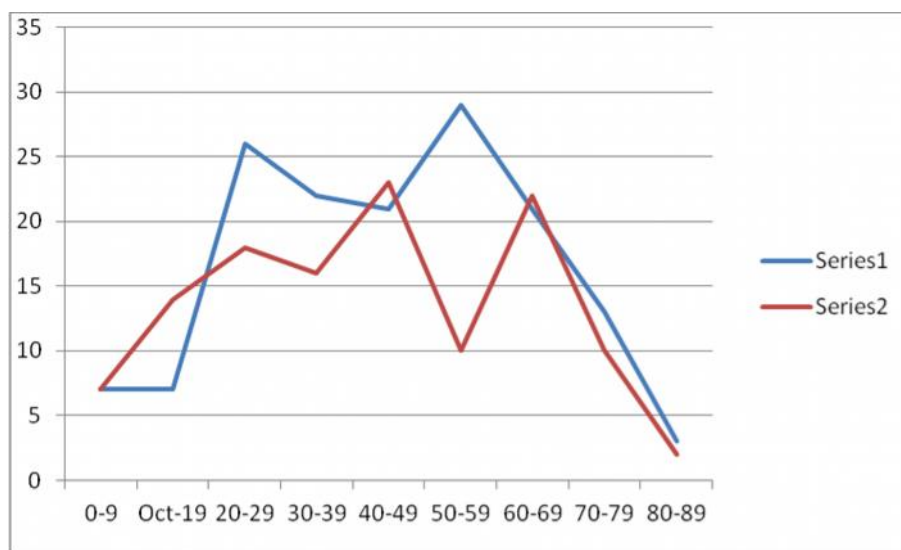
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131 GRAPH 1 SHOWING THE AGE AND SEX DISTRIBUTION OF STUDIED
132 POPULATION (SERIAL 1-MALES AND SERIAL 2-FEMALES)

133

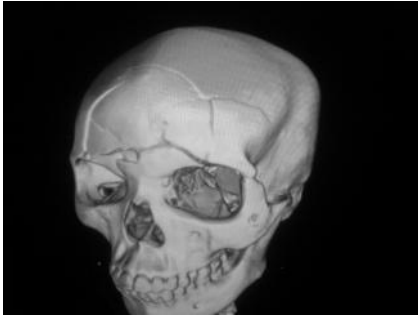
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137 FIGURE 1- 3D VOLUME CRANIO-CEREBRAL CT SHOWING
138 BILATERAL FRACTURES OF FRONTO-PARIETAL CALVARIUM



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140 FIGURE 2- MEDIASTINAL WINDOW OF CHEST CT SHOWING
141 BILATERAL BASAL LUNG PARENCHYMAL CYSTIC LESIONS WITH
142 INTERSTITIAL LESIONS AND SIGNET RINGS (FEATURES OF CYSTIC
143 BRONCHIECTASIS)



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149 **DISCUSSION**

150 It is really gratifying and most commendable that the management of
 151 University of Uyo teaching hospital considered it exigent and paramount to
 152 purchase a 16-slice helical computed tomography (CT) scanner rather than
 153 folding hands and groaning over the delay in the arrival of the CT machine
 154 allocated to it by the 'VAMED Project' of Federal government of Nigeria.
 155 This is definitely a stop gap but a far cry from the expected. This is because this
 156 is the only CT scanner serving the entire people of Akwa Ibom State and even
 157 its environ. Akwa-Ibom state is the highest producer of crude oil and gas in
 158 Nigeria and the state has population over 5 million people and a land area of
 159 6,900 sq Km [4,5]. This translates to one CT scanner per 5 million population.
 160 Whereas as at 1996 (17 years ago), a conducted survey revealed that the
 161 number of CT scanners per 1 million population was 26 in the United States and
 162 64 in Japan [2]. We are not demoralised as a journey of one thousand miles
 163 starts with a step. This is against the backdrop that we are a third world
 164 country with numerous obligations contending with our meagre resources. A
 165 proof of the dire need of CT in the state was the unexpected number of patient
 166 with clinical indications that made themselves available for the free trial and
 167 knobology of the machine after installation. Imagine in that short period of trial
 168 which spanned only from 4th November to 8th November, 2012, 33(11.4%)
 169 patients were scanned with male to female ratio of 1.12:1 despite numerical
 170 scaling down.

171 CT has tremendously transformed much of medical imaging through
 172 providing three-dimensional views of the organ or body region of interest [2].
 173 Three-dimensional imaging endeavours to manifest 3D spatial relationships in
 174 a two-dimensional image [1,6]. Older CT technology usually needs multiple
 175 acquisitions to entirely view some pathologies [1]. But 16-slice multi-detector
 176 CT with its isotropic data sets needs acquisition in only one plane [1].
 177 Subsequent reconstruction in real time to any other desired plane of interest can
 178 be performed to adequately display the pathology [1]. With the introduction of
 179 advanced workstations, 3D imaging can be produced and viewed with user-
 180 friendly real-time interactive display (See figure 1) [1]. Another advantage of
 181 16-slice multi-detector CT is the ability to yield high-resolution volume data
 182 sets not attainable by older spiral CT capability [1]. The modern state of art of
 183 16-slice multi-detector CT is its sub-second acquisition and isotropic data
 184 accompanied by multiple detector rows and fast gantry rotation times, such that
 185 the acquisition time with a 16-slice multi-detector CT can now be reduced by
 186 approximately 25 times that of conventional spiral CT [1].

187 In this study no age group was spared of CT examination with 4.8% being
 188 children below 10 years of age (See table 1). This approximates to the
 189 estimates of the proportion of CT studies that are currently performed in
 190 children which range from 6% to 11% [2]. Congenital anomalies are often
 191 better demonstrated with 3D CT than conventional axial imaging alone, as

192 imaging in the non-axial plane is mandatory for full anomaly definition [1].
 193 The driving force for the growth of CT use in children is reduction in the time
 194 required to perform a scan (now less than 1 second) [2]. This significantly
 195 eliminated the need for anaesthesia to avert child mobility during image
 196 acquisition[2]. However adult bias in CT examinations still remains just like
 197 other studies (See chart 1) [2]. This is not unconnected with high radiation dose
 198 of CT and greater propensity to carcinogenesis in younger age. The risk of
 199 cancer development in CT examinations depends on age, sex and type of CT
 200 examinations [3]. For example 1 in 270 women (1 in 600 men) who underwent
 201 CT coronary angiography at age 40 years will develop cancer from that CT scan
 202 [3]. The risks were approximately doubled for 20 year old patients, but
 203 approximately 50% lower for 60 year old [3].

204 In this study, the most frequent type of CT examinations patients underwent is
 205 cranio-cerebral and this is comparable to other studies (See chart 1) [3]. This
 206 could be due to the limited usefulness of conventional radiography in evaluating
 207 the brain, non-usefulness of ultrasonographic evaluation of the brain on closed
 208 fontanelles and local non-availability of any other neuro-imaging modalities
 209 like MRI. Indications like cerebrovascular accidents, traumatic brain injuries,
 210 headache, space occupying lesions, congenital brain lesions and seizures are
 211 readily evaluated with cranio-cerebral CT [1,7,8,9,19,11,12,13]. The rapid
 212 neuroimaging of a patient that has suffered CVA is a critical preamble to the

213 emergent initiation of thrombolytic therapy [14]. CVA increases with age and is
 214 a frequent cause of death and disability in most parts of the globe [11,15]. CT
 215 can easily distinguish haemorrhagic from ischaemic CVA. Over 16% of patient
 216 who underwent crania-cerebral CT in our study had positive radiographic
 217 features of CVA. CT can readily show hypodensity on hyperacute CT around
 218 the watershed area of the brain as a sensitive, prognostic, and reliable indicator
 219 of the degree of middle cerebral artery (MCA) territory that underwent
 220 infarction [10].

221 Brain herniations are also easily detected by CT and this becomes more useful
 222 when a patient is asymptomatic, awake, alert, and neurologically intact . Brain
 223 herniation is defined as mechanical displacement of brain, cerebrospinal fluid,
 224 or blood vessels outside the compartments in the cranium that they normally
 225 occupy [9]. CT angiography with CT perfusion may represent a rapid
 226 noninvasive technique for diagnosis of brain death [16].

227 The care of the trauma patient is demanding requiring speed and efficiency [17].
 228 This therefore demands an imaging tool that is fast in image acquisition and
 229 permits simultaneous use of resuscitatory equipment. Given its fast imaging
 230 time and ability to produce high resolution images of the skeletal system, 16-
 231 slice multi-detector CT with thin collimation is the cross-sectional study of
 232 choice in both adult and paediatric trauma [1]. In many African countries, road
 233 traffic accident (RTA) is due to recent invasion into transport system by motor

cyclists [18]. A common scenario in the city of Uyo where the CT scanner is located. 20% of all cranio-cerebral CTs in this study were due to trauma with road traffic accident being a major contributor. Computed tomography Scan is effective in delineating soft tissue and bony injuries [19]. In the assessment of acute traumatic injuries, CT with multi-planar reconstructions and 3D mapping has been shown to display between 25% and 75% more sites of pathology compared with radiography (See figure 1) [1]. Three-dimensional CT offers a method of detecting occult fractures not detected by radiography [1]. Both volume-rendered and shaded surface display 3D algorithms as well as multi-planar reconstructed images may be used to determine fracture extent and complexity, but volume-rendered 3D CT is useful for patients with gunshot wounds, where streak artifact can obscure pathology on imaging performed with other CT techniques (conventional axial CT images, multi-planar reconstructions, and 3D shaded surface display images) [1,19].

Abdominal CT was the second most frequent CT done in our centre. Findings of physical examination are notoriously unreliable in some abdominal conditions like blunt abdominal injury with missed intra-abdominal injuries continuing to cause preventable deaths [17]. Unrewarding physical findings may be due to the presence of distracting injuries, altered mental state, and drug/ alcohol intoxication in the patient [17]. CT has shown to be reliable in the evaluation of blunt abdominal trauma in a selected group of patients, with overall

255 sensitivity of 97% , specificity of about 95%. positive predictive value 82% and
 256 negative predictive value 100% [17]. The most commonly injured organs are
 257 the spleen, liver, retroperitoneum, small bowel, kidneys, bladder, colorectum,
 258 diaphragm and pancreas[17]. CT scan remaining the standard criterion for the
 259 detection of solid organ injuries [17]. CT scan of the abdomen can also show
 260 other accompanying injuries, notably vertebral and pelvic fractures and injuries
 261 in the thoracic cavity. CT scans, unlike direct peritoneal lavage (DPL) or
 262 focused assessment with sonography for trauma (FAST) examinations, have the
 263 capability to determine the source of haemorrhage [17]. In addition, many
 264 retroperitoneal injuries go unnoticed with DPL and FAST examinations. The
 265 images can help quantitate the amount of blood in the abdomen and can reveal
 266 individual organs with precision [17]. However CT has marginal sensitivity for
 267 diagnosing diaphragmatic, pancreatic and hollow viscus injuries [17].

268 CT of the chest is superior to chest computed radiography (CR) as it
 269 demonstrates roentgenographic abnormalities more often than CR (See figure
 270 2), provides new diagnostic information and clarifies CR abnormalities [13].
 271 It supplements the combined diagnostic yield of CR and fibroptic
 272 bronchoscopy in some patients like localizing site of bleeding in patients with
 273 haemoptysis [13].

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275 Other CT examinations done in our centre and classified as others in this study
276 were paranasal sinuses, ear , lower limb, upper limb, jaw, angiography, joints
277 and neck. In spine CT, cervical spine CT due to road traffic accident was the
278 commonest in our study. A great many cervical spine fractures are missed on
279 plain radiography and are seen only by CT [20,21].

280 Chronic rhinosinusitis is a frequently encountered disease with its diagnosis
281 relying on clinical judgment based often on vague physical complaints and
282 symptoms like facial pain, headache, postnasal catarrh and fatigue [22].
283 Objective evaluations exist with the introduction of the rigid endoscope and
284 computed tomography (CT) [22]. Currently, CT scanning is the standard
285 imaging in the evaluation of the paranasal sinuses being used in establishing
286 the severity of disease, response to treatment and surgery[22].

287 Over 18% of our brain CTs were normal with no pathology seen. This brings to
288 mind the application of caution in requesting for CT examinations considering
289 its high radiation dose. Radiation doses varied significantly between the
290 different types of CT examinations.. The overall median effective doses ranged
291 from 2 milli-sieverts (mSv) for a routine head CT scan to 31 mSv for a
292 multiphase abdomen and pelvis CT scan [3]. CT is known to deliver much
293 higher radiation doses than conventional radiography[3]. A typical chest CT
294 scan typically delivers more than 100 times the radiation dose of a routine
295 frontal and lateral chest radiograph [3]. This receipt of radiation dose by the

296 patient has been worsened in part from improved CT techniques aim at
 297 increasing its scope in medicine. For example, increased speed of CT image
 298 acquisition allows vascular, cardiac, and multiphase examinations, all
 299 associated with higher doses [3]. Thus, greater use of CT has resulted in a
 300 concurrent increase in the medical exposure to ionizing radiation [3] It has been
 301 reported that 30% or more of the CT examinations currently performed may be
 302 unnecessary [3]. Our lower value of 18% was due to the fact that there was a
 303 backlog of patients already seen by their clinicians with obvious or gross
 304 pathology who could not assess CT due to non-availability or cost. The
 305 European Commission Office of Radiation Protection and the Canadian
 306 Association of Radiologists developed guidelines highlighting where CT
 307 imaging should be curtailed [3]. This included repeating investigations that
 308 have already been done; over-investigating, imaging when it is unlikely to
 309 affect patient management because a positive finding is irrelevant such as
 310 surveillance of incidental findings [3].

311 Unrelated pathologies in the course of our CT studies were diverse constituting
 312 16.1%.. These included Sino-nasal polyps, Rhinosinusitis, Foramina parietalis
 313 permagna, Hyperostosis frontalis interna, lytic skull lesions, Pansinusitis,
 314 Mastoiditis, Renal cortical cyst, Non-pneumatization of sphenoid sinus,
 315 Osteochondritis dissecans and Phantom disc.

316 The limitations of our study include its retrospective nature with
317 exclusion of some patients with incomplete data. Also, our study was not on
318 the nitty-gritty of CT findings as that will be basis of future studies.

319 **CONCLUSION**

320 Recent acquisition and use of computed tomographic scanner in University of
321 Uyo teaching hospital, Uyo, Nigeria has facilitated patient management in the
322 hospital with the influx of patients to Radiology Department for different CT
323 investigations.

324 The commonest CT examinations in Uyo is cranio-cerebral followed by
325 abdomen. The commonest indication of such cranio-cerbral CT is trauma
326 followed by cerebrovascular accident.

327 One 16 slice helical CT is a good step but grossly inadequate for the
328 population. Additional acquisitions of CT and magnetic resonance imaging
329 machines will be most complementary.

330

331 **ACNOWLEDGEMENTS**

332 Chief Medical Director, University of Uyo teaching hospital (Prof Etete
333 Peters), Former CMAC, UUTH (Dr Emmem Bassey) and present CMAC (Dr

334 P. Udoh) for all concerted interest in equipping Radiology Department in less
335 than a year.

336 The head of department of Radiology (Dr M C Ikpe) and other Radiology
337 department staff for all the energy spent in the installation.

338 The Deputy Director of imaging (Mr Ekanem) and his team of Imaging
339 scientists for their dedication in producing quality CT images.

340 Departmental Record officers and other Administrative Officers.

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