

بسم الله الرحمن الرحيم

**Sudan University of Science and
Technology**
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**Evaluation of Quality Control Protocols for
Computed Tomography Scanners
in Khartoum Centers**

A thesis submitted in partial fulfillment for the requirements of the
Degree of MSc. In Diagnostic Technology

By

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بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

قال الله تعالى :

﴿قُلْ هَلْ يَسْتَوِي الَّذِينَ يَعْلَمُونَ
وَالَّذِينَ لَا يَعْلَمُونَ إِنَّمَا يَذُكُرُ أُولَى
الْأَلْبَابِ ۚ﴾

صدق الله العظيم

سورة الزمر

الآية (9)

Dedication

To:

My parents for their patience and
encouragement,

My brothers and sisters for their help and
support,

My friends for their valuable support,

And

To the dearest people in my life.

I dedicated this work.

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ABBREVIATIONS

CT	Computed Tomography
Hu	Hounsfield unit
QA	Quality Assurance
QC	Quality Control
MTF	Modulation Transfer Function
PSF	Point Spread Function
LSF	Line Spread Function
DSR	Dynamic Spatial Reconstruction
EBCT	Electron Beam Computed Tomography
ROI	Region of Interest
CRT	Cathode Ray Tube
3D	Three dimension
SAEC	Sudan Atomic Energy Commission
GE	General Electric
AAPM	American Association of Physic In Medicine
RP TC	Radiation Protection Technical Committee
FOV	Filed of View
IAEA	International Atomic Energy Agency

ABSTRACT

Quality control (QC) in any activity refers to the routine and special procedures developed to ensure that the final product is of consistently high quality. Quality control in diagnostic radiology

requires a planned, continuous program of evaluation and surveillance of radiologic equipment and procedures.

The main purpose of this study is to assess the performance of some of CT scanners used for radiodiagnosis and to evaluate the quality control program in Khartoum State Computed Tomography (CT) centers.

The main parameters monitored and tested during the QC program include, average CT number of water, field uniformity, noise, lower contrast resolution, high contrast resolution, slice thickness, bed indexing, couch travel accuracy, light field accuracy, contrast scale and linearity.

The total tested CT machines were 7 out of 10. All of the tested scanners passed the following tests field uniformity, noise characteristics, bed index, high contrast resolution, light field accuracy, slice thickness, couch travel accuracy, contrast scale and linearity. However - for some of these scanners - deviations of the results from the standard values have reached the maximum tolerance and this indicates that those machines are in bad need for preventive maintenance. The percentage of success for other tests were 57.1%, and 50% for the average CT number of water, and low contrast resolution test respectively.

The study showed also that there is no QA program performed regularly in most of the CT centers involved in this study,

such program includes - among others - QC tests, calibration, staff training, preventive maintenance and repair. In addition most of centre do not have the QC tools and depend on the service engineer in calibrating and testing of their machines. Finally the study showed that there is more efforts are needed to enforce the SAEC act that regulates the use of radiation in different applications including the medical field.

ملخص الأطروحة

عملية ضبط الجودة لأى نشاط هى إجراء الاختبارات الروتينية والخاصة للتأكد من الحصول على منتج نهائى ذو جودة عالية. فى مجال الأشعة التشخيصية تحتاج إلى وضع برنامج مستمر لتقويم ومراقبة أداء أجهزة الأشعة وإجراءات التشخيص الإشعاعى.

الهدف الرئيس من هذه الدراسة هو تقويم أداء بعض أجهزة الأشعة المقطعية فى المراكز الطبية بولاية الخرطوم بالإضافة إلى الوقوف على مستوى تطبيق برامج ضبط الجودة فى تلك المراكز.

المتغيرات التى يتم مراقبتها واختبارها من خلال برنامج ضبط الجودة شملت متوسط الرقم المقطعى للماء، تجانس الحقل، الضجيج، درجة الميز للتباين المنخفض، درجة ميز للتباين العالى، سمك الشريحة، المسافة بين الشرائح، دقة حركة طاولة الفحص، دقة الحقل الضوئى والخطية.

أجريت هذه الدراسة على (7) أجهزة أشعة مقطعية من أصل (10) "جهاز عاملة بولاية الخرطوم". وأوضحت النتائج إلى نجاح كل الأجهزة المختبرة فى الاختبارات التالية تجانس الحقل، الضجيج، المسافة بين الشرائح، درجة ميز للتباين العالى، دقة الحقل الضوئى، سمك الشريحة، دقة حركة طاولة الفحص، تدرج التباين والخطية. غير أن النتائج أيضا أوضحت بأن بعض الأجهزة قد بلغت الحد الأقصى للانحراف عن القيم المعيارية وهذا يعنى بأنها فى حاجة لإخضاعها للصيانة الوقائية.

نسبة النجاح فى الاختبارات الأخرى كانت 57% و 50% لكل من متوسط رقم التصوير المقطعى، درجة الميز للتباين المنخفض على الترتيب.

أتضح من خلال الدراسة أيضا عدم وجود تطبيق منتظم لبرنامج ضمان الجودة فى أغلب المراكز التى شملتها الدراسة وهذا البرنامج يشمل الكثير من الإجراءات منها قياسات ضبط الجودة ، المعايير ، التدريب للعاملين والصيانة الدورية وإصلاح للأجهزة. بالإضافة إلى ذلك فقد أوضحت الدراسة بأن أغلب المراكز لا تمتلك أجهزة قياس ضبط الجودة وأنها تعتمد على الشركات المستوردة للأجهزة فى عمليات المعايرة والصيانة. أخيرا فإن الدراسة أوضحت بأن هناك الكثير من الجهود التى يجب أن تبذل لتنفيذ قانون هيئة الطاقة الذرية والذى ينظم التعامل بمصادر الإشعاع فى جميع المجالات بما فيها المجال الطبى.

