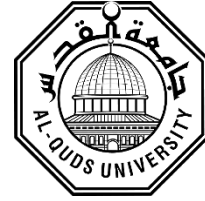


**Deanship of Graduate Studies
Al-Quds University**



**Low Dose Brain CT, Comparative Study With Brain Post
Processing Algorithm**

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Processing Algorithm**

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Thesis Approval

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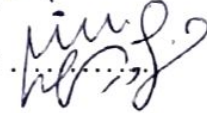
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Declaration

I certify that this thesis submitted for the degree of master, is the result of my own research, except where otherwise acknowledged, and that thesis has not been submitted for a higher degree to any other university or institution.

Signed : 

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Date: 21.1.2020

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Abstract

Computed tomography (CT) scanners and CT exams increase continuously. Researcher aims to minimize ionizing radiation dose by introducing new CT protocols, providing diagnostic CT images with lower radiation dose to patient. However, such studies encounter difficulties, when radiation dose is lowered, the quality of images becomes less and sometimes not diagnostic. In this study, the researcher aims to provide low dose brain CT protocol, and then determine if the images match quality criteria of Brain CT; and determine diagnostic appearance of the images. Then, the researchers will compare the result obtained from source Brain CT, and Brain post processing algorithm to determine which one of them provides better diagnostic image, and has a better match for quality criteria of Brain CT, by the Numerical criterion (1: weak, 2: moderate, 3:perfect) which used by expert medical imaging technologists, On a sample of 35 patients; the first brain CT was conducted by 22 milli-gray (mGy) volume computed tomography dose index ($CTDI_{vol}$); the resulting image was noisy, and has poor match for quality criteria, so more radiation needed to increase the quality of the images, here $CTDI_{vol}$ was raised to 25 mGy, then to 30 mGy, and finally to 33.8 mGy. At this point, the image was acceptable to complete the study. The researcher have engaged four radiologists to determine if the image provides diagnostic appearance, then six expert medical imaging technologists were involved to determine the quality criteria. These steps were followed for Brain CT before and after applying post processing algorithm. Then the results compared with the reference study for brain CT. the result for low dose brain CT was diagnostic and match quality criteria for brain CT, after applying brain post processing algorithm the images diagnostic appearance disturbed, the suggested protocol by the study provide 47%dose reduction,

from the standard protocol which use 63 mGy. The problem of signal reduction solved by, using iDose⁴ (Fourth-generation hybrid iterative reconstruction algorithm introduced by Philips) which improve signal to noise ratio (SNR), increase slice thickness to 5 millimeter (mm), and the use of overlap increment to solve the problem of partial volume and increase number of acquired slices.

التصوير الطبقي للدماغ باستخدام جرعة شعاعية منخفضة, دراسة مقارنة مع خوارزمية تحسين التباين

إعداد: حمزه محمود عبد الرحيم العرجه

إشراف: د. محمد حجوج

الملخص

هناك ازدياد ملحوظ في عدد أجهزة التصوير الطبقي, وعدد الفحوصات التي يتم طلبها. يهدف الباحث في هذه الدراسة الى إضافة بروتوكول لتصوير الدماغ يستخدم كمية من الاشعة أقل من البروتوكول المعياري, مع إمكانية توفير صور تشخيصية, ولكن تواجه مثل هذه الدراسات صعوبات, عندما يتم تقليل الجرعة الإشعاعية المستخدمة في التصوير, تصبح جودة الصور أقل وأحياناً لا تكون تشخيصية. في هذه الدراسة, يهدف الباحث إلى إضافة بروتوكول يستخدم جرعة منخفضة من الاشعة مقارنة بالبروتوكول المعياري, ومن ثم تحديد ما إذا كانت الصور تطابق معايير الجودة لصور الدماغ؛ إضافة الى تحديد المظهر التشخيصي للصور. بعد ذلك سيتم عمل مقارنة للصور الطبقيّة الأولى, والصور الطبقيّة بعد تطبيق لوجار يتم تحسين التباين, لتحديد أي منها يوفر صورة تشخيصية أفضل, ولديه تطابق أفضل لمعايير الجودة لصور الدماغ, باستخدام المعيار العددي (1): ضعيف, 2: متوسط, 3: مثالي) وتم استخدام هذه المعايير من قبل فنيي أشعة ذوي خبرة, تم عمل الصورة الأولى باستخدام 22mGy, كانت النتيجة صورة غير تشخيصية وبحاجة لكمية أكبر من الاشعة لتقليل التشويش, تم رفع الجرعة المستخدمة الى 25mGy ثم 30mGy وأخيرا 33.8mGy عند هذه النقطة كانت الصور ملائمة لإكمال الدراسة, وبعد فحص الصور والتأكد من إمكانية استخدامها في التشخيص قام الباحث بإشراك أربعة أخصائيين أشعة لتحديد ما إذا كانت الصور تشخيصية باستخدام المعيار الرقمي (1: تشخيصي, 2: غير تشخيصي), تم اتباع هذه الخطوات قبل وبعد تطبيق خوارزمية تحسين التباين. ثم تمت

مقارنة النتائج مع الدراسة المرجعية لصور الدماغ، كانت النتائج صور تشخيصية متوافقة مع معيار جودة صور الدماغ، يوفر

البروتوكول المقترح من الدراسة تخفيضًا بنسبة 47٪ للجرعة الإشعاعية، مقارنة بالبروتوكول المرجعي الذي يستخدم 63

mGy. تم حل مشكلة التشويش عن طريق استخدام $iDose^4$ (الجيل الرابع من الأنظمة الهجينة، لبناء ومعالجة الصور)

لتحسين جودة الصورة، وتمت زيادة سماكة المقطع إلى 5 ملليمتر (مم) من أجل تخفيض التشويش، واستخدمت المقاطع

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Contents

Acknowledgements.....	i
Abstract.....	ii
المخلص.....	iv
Contents	vi
list of abbreviations.....	x
List of figures.....	xi
Lists of tables	xv
Chapter I Introduction.....	1
1.1 Introduction.....	1
1.2 Computed tomography.....	2
1.3 Problem statement.....	3
1.4 Justifications	3
1.5 Study objectives.....	4
Chapter II Literature Review	5
2.1 Risks from Ionizing Radiation.....	5
2.2 Previous study.....	6
2.3 A standard protocol for brain CT.....	9
Chapter III CT scan parameters	10
3.1 Peak Kilovoltage Kvp.....	10

3.2	Milliampere-Seconds mAs.....	11
3.3	Reconstruction slice thickness	11
3.4	Increment	12
3.5	Pitch	12
3.6	Reconstruction Algorithms	13
3.7	Window Level.....	14
3.8	Window Width.....	14
3.9	Helical (Spiral) Scanning.....	15
3.10	Axial scan method.....	16
3.11	Dose modulation	16
3.12	Rotation Time	17
3.13	Scan angle	17
3.14	CTDI _{vol} & DLP:.....	18
3.15	Brain CT protocol:	18
3.16	Quality Criteria for Brain CT.....	18
3.17	Brain post-processing algorithm (CNR improvement algorithm)	21
3.18	iDose ⁴ (SNR improvement algorithm).....	22
3.18.1	iDose ⁴ and Dose Reduction.....	23
3.18.2	iDose ⁴ and spatial resolution	24
	Chapter IV Methodology	25

4.1	Materials and Methods.....	25
4.2	The problem of signal reduction.....	26
4.3	Applying Brain Post Processing algorithm.....	26
4.4	Study population.....	26
4.5	Study sample.....	26
4.6	Inclusion and exclusion criteria.....	27
4.7	Study instruments.....	27
4.8	Patient file.....	28
4.9	Ethical approval.....	28
4.10	Statistical test.....	28
4.11	Quality criteria for brain CT.....	29
4.12	Measuring Criteria for Image Quality.....	29
	Chapter V Results.....	31
5.1	Results for diagnostic appearance.....	31
5.2	Results for the diagnostic appearance after applying Brain processing algorithm.....	34
5.3	Diagnostic appearance.....	35
5.4	Results for Quality criteria for brain CT.....	37
5.5	Statistical test for quality criteria Brain CT.....	37
5.5.1	Statistical test for sharp reproduction between white and grey matter.....	38
5.5.2	Statistical test for sharp reproduction of the basal ganglia.....	39

5.5.3	Statistical test for sharp reproduction of the ventricular system	41
5.5.4	Statistical test for sharp reproduction of the cerebrospinal fluid space around the mesencephalon	42
5.5.5	Statistical test for sharp reproduction of the cerebrospinal fluid space over the brain	43
5.6	CTDI _{vol} and DLP	44
5.1	Statistical test for CTDI _{vol} and DLP	45
5.2	Brief results for Diagnostic appearance	47
5.3	Brief results for CTDI _{vol} and DLP	48
5.4	Brief Discussion.....	49
5.5	Quality criteria for brain CT	49
5.5.1	Diagnostic appearance	49
5.5.2	CTDI and DLP.....	49
5.6	Study limitation.....	50
5.7	Conclusion	50
5.8	Future perspective	51

list of abbreviations

Abbreviation	Definition	Page
CT	Computed Tomography	II
CTDI _{vol}	volume computed tomography dose index	II
mGy	Milli-Gray	II
iDose ⁴	Fourth-generation hybrid iterative reconstruction algorithm introduced by Philips	III
mm	Millimeter	III
DRLs	Diagnostic Reference Levels	1
DNA	Deoxyribonucleic acid	2
ED	Effective Dose	2
CNR	Contrast to noise ratio	2
MDCT	Multidetector Computed Tomography	2
ALARA	As Low As Reasonably achievable	3
mSv	millisieverts	5
mAs	Milliampere-seconds	7
Kvp	Peak Kilovoltage	10
s	seconds	11
SNR	Signal to Noise Ratio	11
DLP	Dose Length Product	18
CSF	Cerebrospinal fluid	20
DICOM	Digital Imaging and Communications in Medicine	27
PRCS	Palestinian red crescent society	28

List of figures

Figure 1: standard (A) and low dose (B) CT scans. Chronic lacunar infarct (yellow arrow): the lesion is well seen only with the standard technique (A) (11).	9
Figure 2: On the left is an image by reconstruction slice thickness 5mm, and on the right is an image by 1.25 mm.	11
Figure 3: increment type and slices shape in CT.	12
Figure 4: Deferent pitches describe deferent shape slices.	13
Figure 5: Philips ingenuity 64 slice reconstruction filters: On the Left smooth filter, in the middle sharp filter, on the right standard filter used by the study.	14
Figure 6: Window level, window center (17).	15
Figure 7: acquisition type in CT, A: axial, B:spiral (20)	16
Figure 8: Dose modulation curve, radiation dose increased, or reduced according to the amount of attenuation in the scout image.	17
Figure 9: The left-hand side with the brain processing algorithm, the right-hand side without it, this image shows a clear difference between white and gray matter, but the brain processing algorithm increases the deference in a clear way.	19
Figure 10: The left-hand side with the brain processing algorithm the right-hand side without it, here, the caudate nucleus is shown clearly, and more clearly with a brain processing algorithm.	19
Figure 11: The left-hand side with the brain processing algorithm, the right-hand side without it, both lateral ventricles will visualized, more obvious with the algorithm.	20