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Original article

Investigating the Influence of Tube Voltage and Current Variations on CT Number-RED Conversion Curves for Radiotherapy CT Scanner

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ABSTRACT

CT simulation is the first chain in radiotherapy treatment, the patient image is acquired by CT scanner to determine the exact location and densities of patient organs in specific coordinate called Pixel, each pixel has a unit called CT number or Hounsfield unit (HU) which representing the linear attenuation coefficient value of X-ray beam that interacts with each different tissue density. on the other hand, Electron density (ED) is the number of electrons contained by certain tissue of specific density, the ratio between each tissue electron density and water electron density is called relative electron density (RED), the conversion curve between CT number and RED should be measured and transferred to the treatment planning system (TPS) which are then used in the dose calculation algorithms. This study aims to evaluate how variations in tube voltage and current affect CT number-RED conversion curves. Utilizing a GE Lightspeed-RT CT scanner and CIRS (062M) phantom with inserts of diverse tissue densities, images were obtained at tube voltages of 80, 100, 120, and 140kV, at constant settings of tube currents ranging from 50 to 380mA, and vice versa. CT number mean and standard deviation were recorded for all inserts at different settings using Micro Dicom viewer software. Tube voltage variation at constant current affected high RED materials (dense bone), while tube current variation at constant voltage minimally impacted the CT-RED curve, except at low tube voltage (80kV). Considering evidence from this study and other studies on CT number's influence on dose calculation, it is advisable to account for scanner settings and specific CT-ED look-up tables, particularly in scenarios involving high-density materials, for accurate radiotherapy treatment planning

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INTRODUCTION

CT simulation is the first chain in radiotherapy treatment, the patient image is acquired by CT scanner to determine the exact location and densities of patient organs in specific coordinate called Pixel, Computed Tomography (CT) measures the attenuation coefficient of an object and converts the value assigned to each voxel into a CT number [1]. The CT number of a material is defined by its linear attenuation coefficient μ and the attenuation coefficient of water.

$$CT\ number = 1000 \times \frac{\mu - \mu_{water}}{\mu_{water}} \quad (1)$$

The unit for CT numbers is Hounsfield units (HU); from the definition, water is zero HU and air is -1000 HU [2]. on the other hand, Electron density (ED) is the number of electrons contained by certain tissue of specific density, the ratio between each tissue electron density and water electron density is called relative electron density (RED) [2]

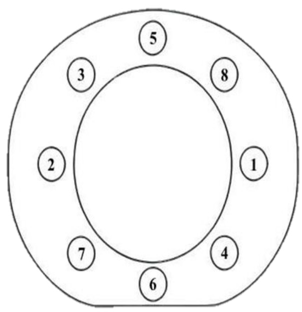
The relationship between material electron density (ED) and image pixel intensity in computed tomography (CT) is used extensively by contemporary radiotherapy dose calculation algorithms. This relationship is usually determined experimentally for specific settings of the scanner's X-ray tube kilovoltage (kV), beam current (mA) and possibly field-of-view (FOV), and the reconstruction algorithm used to determine pixel intensities from X-ray transmission measurements [3]. The correlation between CT number and electron density is derived from a CT scan of the materials with known electron densities and the points between the derived relations are filled up by interpolations. This relation is applied during the dose calculation based on CT image and thus, the accurate measurement of CT number and applying the value to the treatment planning system (TPS) is fundamental to the radiation therapy.[1] It is advantageous if the same CT-ED curve can be used regardless of the settings used on the CT scanner at imaging. Attenuation coefficient varies with a chosen X-ray tube voltage (kV) and current (mA) from the CT scanner since attenuation coefficient has an energy dependent property and many literatures [1-2] have discovered the significant CT number changes in different kV and current for most materials and therefore, application of the correct CT number to electron density conversion curve is essential. However, in practice, many institutions use various tube voltages and current for CT images depending upon the section of the body or the size of the patients but often, a single CT number to electron density conversion curve is utilized for the radiation therapy plan. Although the uncertainties in dose calculation caused by the various CT tube voltages have been quantified in some literatures by applying different conversion curves.[3]

Different literatures investigated this variation, [4] investigated the influence of tube voltage (kV) and current (mA) on the resulting relationship of computed tomography number to electron density (CT-ED) for a wide-bore GE scanner. They examined the influence of kV and mA scan settings in combination with a 16-bit image reconstruction algorithm made available via the scanner software and which allowed resolution of CT numbers for high density materials. By using titanium and stainless-steel inserts in an electron density phantom, mA variation was found to have minimal impact on the CT-ED relationship, whereas variation in kV led to significant differences in CT number for the high density materials.[2] investigated the impact of variation of kVp and current of siemens somatom CT scanner on CT number -RED curve using the commercial electron density phantom called (CIRS model 062 M) they conclude that both CT x-ray tube voltages and currents variations have considerable effects on the RED-CT number relationships. For different CT current values, the differences between RED-CT number curves decrease when the CT voltages increase from 70 to 100 kV. At CT voltages 120 and 140 kV the differences are negligible whatever the CT current value is. They investigated low tube voltage 70kV.

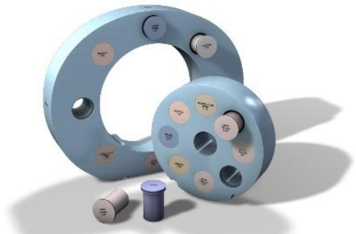
The CT number -RED curve impacts the accuracy of the dose calculation of the treatment planning system. Our aim of this study is to investigate the influence of the variation of kV and mA on the CT number – RED curves.

METHODS

GE Lightspeed-16 RT CT scanner (Radiotherapy department Tripoli University Hospital) was used to acquire the data in this study. The tube voltage of 80 kVp, 100 kVp, 120 kVp, and 140 kVp and tube current was 50, 100, 200, 300, 380mA were tested to evaluate the impact on the CT number -RED curves.

Commercial electron density phantom (CIRS Model 062 M) was used in this study. The body phantom material is made of tissue equivalent material with RED equal to 0.998 Figure 1. (a). The phantom contains 17 holes equally distributed eight in the inner circle and others in the outer circle each hole contains insert with different material with known RED values Table 1 the distribution and numbering of the insets was shown in Figure 1. (b) . Micro Dicom viewer software is used to obtain the CT	

number of each insert material.



(a)	(b)

Figure 1. (a) Commercial electron density phantom (CIRS Model 062 M); (b) Description of tissue equivalent material distribution and numbering

Table .1. The physical density and RED of the tissue equivalent materials inserts of the CIRS.

Location in Figure 2	*material type*	*physical density (g/cm^3)*	*Relative Electron Density*
1	*LUNG (Inhale)*	0.2	0.20
2	*LUNG (Exhale)*	0.5	0.50
3	*ADIPOSE*	0.96	0.95
4	*BREAST*	0.99	0.98
5	*MUSCLE*	1.06	1.04
6	*LIVER*	1.07	1.05
7	*BONE 200 mg/cc*	1.16	1.11
8	*BONE 800 mg/cc*	1.53	1.46

Experiment set up

CIRS phantom is placed on the CT couch. The phantom is then adjusted and leveled using the alignment lasers and the “graved crosses” on the CIRS phantom figure 2.

Image acquires

CT images were acquired with 2.5- and 5-mm slice thickness, 1 second acquisition time, 512 × 512-pixel matrix, field of view (FOV) of 50 cm diameter, the scan was acquired at a constant x-ray tube current 50,100,200,300,380mA at different step of tube voltage 80,100,120,140kV and vice versa

Data analysis

Images obtained for the CIRS phantom were exported Micro Dicom viewer software. Central slices of the phantom were used for analyzation, using circle region of interest (ROI) 1cm^2.Where the mean value of CT numbers and their standard deviation were obtained for 17 inserts material, we observe that there not any difference between the central inserts and the peripheral inserts, there for we decide to collect the HU of the 8 inserts peripheral Figure.3. The CT number relative electron density curve was obtained:

- CT x-ray tube voltage variation:
  For each step of tube current 50,100, 200, 300 and 380mA, the HU value were measured at different tube voltage 80,100,120 and 140kV , the CT number -RED curves were drawn for each step
- CT x-ray tube current variation:
  For each step of tube voltage 80, 100, 120 and 140kV, the HU values were measured at different tube current 50, 100, 200, 300 and 380 mA , the CT number -RED curves were drawn for each step

The difference between Hu value for two setting steps (ΔHU) were calculated and compared, standard deviation of this different were calculated using.

$$\sigma_{A-B} = \sqrt{(\sigma_A)^2 - (\sigma_B)^2} \qquad (2)$$

Where σ_A and σ_B is the standard deviation for setting A and B respectively, $\sigma_{A\text{-}B}$ is standard deviation of the different of CT numbers (ΔHU)

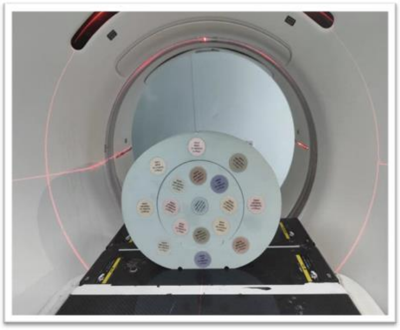


Figure 2. Experiment setup.

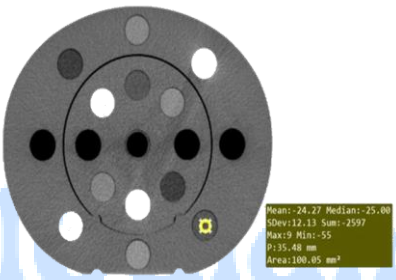


Figure 3. data analysis by Micro Dicom viewer software

RESULTS AND DISCUSSION

Table 2 demonstrates the variation of CT numbers (Hounsfield Units) across different tube voltages (80, 100, 120, and 140 kV) while maintaining a constant tube current of 380 mA. Notable observations from the table include the minimal change in CT numbers for soft tissues such as lung, adipose tissue, breast, muscle, and liver across the range of tube voltages studied. Conversely, significant changes are observed in dense tissues like bone, where CT numbers are notably higher at lower tube voltages (80 kV) and decrease as the tube voltage increases, resulting in lower CT numbers at higher tube voltages (140 kV). Tube voltage plays a critical role in determining the energy spectrum of X-ray photons emitted by the CT scanner. Higher tube voltages result in X-ray photons with greater energy levels. Soft tissues, including lung, adipose tissue, breast, muscle, and liver, exhibit relatively consistent CT numbers across different tube voltages. This is because these tissues have similar attenuation properties within the energy range provided by the CT scanner. The differences in their CT numbers across tube voltages are minor compared to the variations seen in dense tissues like bone. Dense tissues like bone demonstrate higher attenuation of X-ray photons due to their higher atomic number and density. At lower tube voltages (e.g., 80 kV), X-ray photons are more likely to undergo photoelectric absorption, resulting in increased attenuation and higher CT numbers. As the tube voltage increases, X-ray photons penetrate tissues more effectively, leading to reduced photoelectric absorption and lower CT numbers for dense tissues like bone.

Table 2. CT numbers (Hounsfield Units, HU) across varying tube voltages specifically (80 kV, 100 kV, 120 kV, and 140 kV) while maintaining a constant tube current of 380 mA.

No.	Tissue equivalent	RED	HU^{80KV}	HU^{100KV}	HU^{120KV}	HU^{140KV}
1	LUNG (Inhale)	0.20	-749.0	-750.9	-750.5	-752.7
2	LUNG (Exhale)	0.50	-479.5	-486.4	-487.3	-487.9
3	ADIPOSE	0.95	-77.1	-68.4	-61.9	-58.3

4	***BREAST***	0.98	-37.0	-27.1	-24.3	-20.2
5	***MUSCLE***	1.04	56.8	56.7	55.8	53.9
6	***LIVER***	1.05	75.0	71.8	73.3	70.2
7	***BONE 200 mg/cc***	1.11	307.9	262.2	228.1	203.7
8	***BONE 800 mg/cc***	1.46	1210.4	1008.3	886.9	799.1

Figure 4 represents the complex interplay between relative electron density (RED) and CT numbers (Hounsfield Units) across a range of X-ray tube voltages (80, 100, 120, and 140 kV) while maintaining a constant tube current of 380 mA. The fork-shaped curve indicates a nonlinear relationship between RED and CT numbers. This suggests that the attenuation of X-rays through various materials is not directly proportional to their RED values but is influenced by other factors such as energy-dependent interactions.

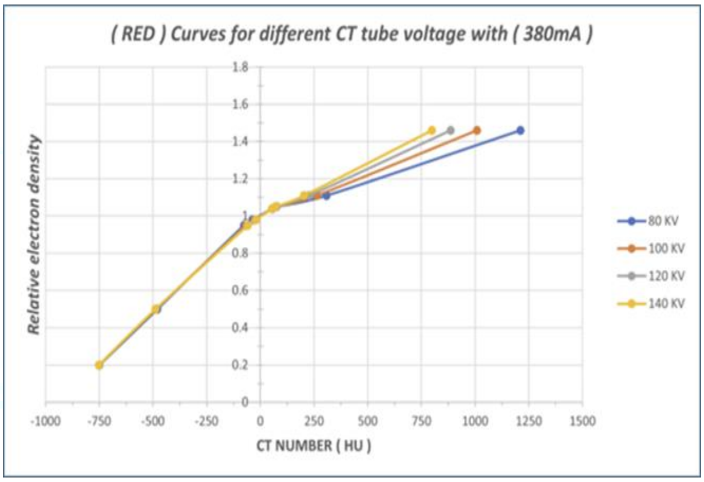


Figure 4. The variation of relative Electron Density (RED) Curves with the changes in CT x-ray tube kilo-voltage.

Below HU value of 75, the RED–CT number curves maintain relative consistency across different tube voltages. This consistency reflects the similar attenuation properties of soft tissues within this density range, where interactions such as Compton scattering dominate and are less affected by changes in tube voltage. Beyond HU value of 75, the RED–CT number curves diverge noticeably across different tube voltages. This divergence implies that the relationship between RED and CT numbers becomes more pronounced as the density or atomic composition of materials increases. Maximum Divergence for High-density Materials The most significant divergence between the RED–CT number curves is observed for high-density materials, exemplified by dense bone with a physical density of (1.53 g/cm^3). This indicates that the attenuation properties of such materials are highly sensitive to variations in tube voltage, likely due to the dominance of photoelectric absorption interactions at higher energies. The trend of RED-CT number curves due to voltage variation agreed with previous publications [2-1].

Table.3 investigated the difference between CT numbers (HU) at tube voltages of 80 kV (HU^{80kV}) and 140 kV (HU^{140kV}) at a constant tube current of 50 mA. Notably, the maximum difference observed was ΔHU (264 ± 106) for dense bone (800 mg/cc), which corresponds to a relative electron density (RED) of 1.46 indicating high-density tissue equivalence. Conversely, the minimum difference recorded was ΔHU (12 ± 76) for breast tissue, (RED is 0.98). Our measurement of dense bone RED 1.46, using CT x-ray voltage 80 ,120 and 140 kV at constant CT current 100mA are higher of the previous studies in 120, 140kV, at 80kV is lower. Our CT number value was in order of (1166, 876.8 and 795 HU) where their value is (1212, 853 and 780 HU respectively) [2]. The observed discrepancies may also be attributed to variances among various scanner types.

Table.4 shows the difference between CT numbers (Hounsfield Units, HU) at tube voltages of 80 kV (HU^{80kV}) and 140 kV (HU^{140kV}) while maintaining a constant tube current of 380 mA. Notably, the maximum observed difference was 411 ± 41 HU for dense bone with a density of 800 mg/cc with (RED 1.46), signifying high-density tissue equivalence. In contrast, the minimum difference recorded was 2.9 ± 23.8 HU for muscle tissue (RED 1.0), these results are the same as in last published research [2].

Table 3. The difference between the CT number (HU) determined at HU^{80KV} and HU^{140KV} with tube current 50mA for different tissue equivalent of various (RED).

No.	Tissue equivalent	RED	HU^{80KV}	$\pm\sigma_A$	HU^{140KV}	$\pm\sigma_B$	ΔHU	$\pm\sigma_{A-B}$
1	LUNG (Inhale)	0.2	-718	70	-756	20	37	72
2	LUNG (Exhale)	0.5	-463	74	-488	24	25	77
3	ADIPOSE	0.95	-77	59	-57	24	-21	64
4	BREAST	0.98	-36	72	-23	24	-12	76
5	MUSCLE	1.04	69	60	51	23	18	64
6	LIVER	1.05	109	76	70	27	39	81
7	BONE 200 mg/cc	1.11	266	92	204	28	62	96
8	BONE 800 mg/cc	1.46	1063	100	799	35	264	106

Table 4. The difference between the CT number (HU) determined at HU^{80KV} and HU^{140KV} with tube current 380mA for different tissue equivalent of various (RED).

No.	Tissue equivalent	RED	HU^{80KV}	$\pm\sigma_A$	HU^{140KV}	$\pm\sigma_B$	ΔHU	$\pm\sigma_{A-B}$
1	LUNG (Inhale)	0.20	-749.0	20.5	-752.7	7.3	3.7	21.8
2	LUNG (Exhale)	0.50	-479.5	26.0	-487.9	8.0	8.4	27.2
3	ADIPOSE	0.95	-77.1	26.4	-58.3	7.6	-18.8	27.5
4	BREAST	0.98	-37.0	28.0	-20.2	8.0	-16.9	29.1
5	MUSCLE	1.04	56.8	22.9	53.9	6.7	2.9	23.8
6	LIVER	1.05	75.0	23.4	70.2	10.4	4.8	25.6
7	BONE 200 mg/cc	1.11	307.9	39.0	203.7	9.3	104.3	40.1
8	BONE 800 mg/cc	1.46	1210.4	39.4	799.1	10.8	411.3	40.9

Figures (5-8) illustrate the variation of CT number values according to changing x-ray CT tube current mA at constant CT tube voltage 80,100,120 and 140kV respectively for different RED tissue material. Figure.5 shows that at constant low X-ray CT tube voltage 80kV and different X-ray CT tube current, there are slight differences in CT number of low and high RED tissue special at 50mA. Figure (6-8) shows that for CT X-ray tube voltage (100, 120 and 140kV) the CT number - RED curves are close to each other for all Ct x-ray tube currents investigated.

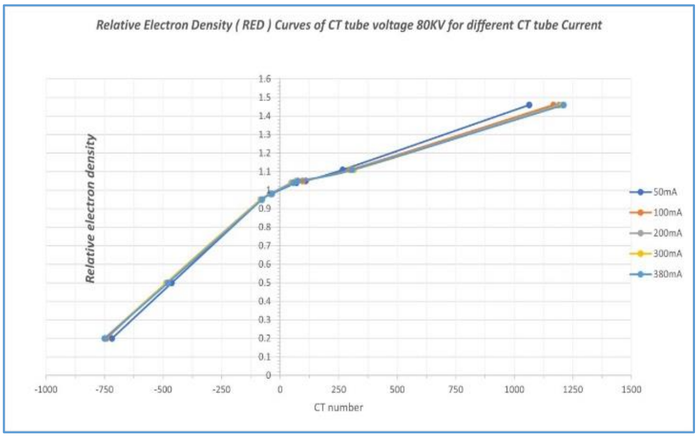


Figure 5. The effect of CT x-ray tube current (mA) variations on the relative electron density curves at tube voltage 80kV.

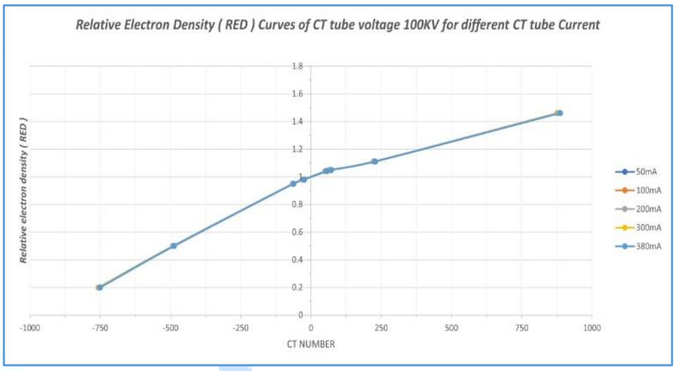


Figure 6. The effect of CT x-ray tube current (mA) variations on the relative electron density curves at tube voltage 100 kV.

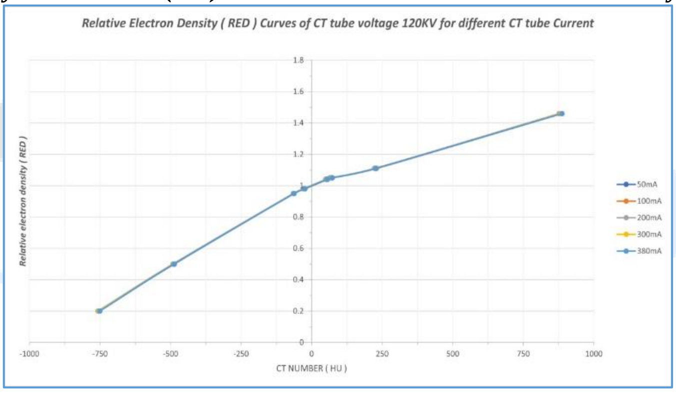


Figure 7. The effect of CT x-ray tube current (mA) variations on the relative electron density curves at tube voltage 120 kV.

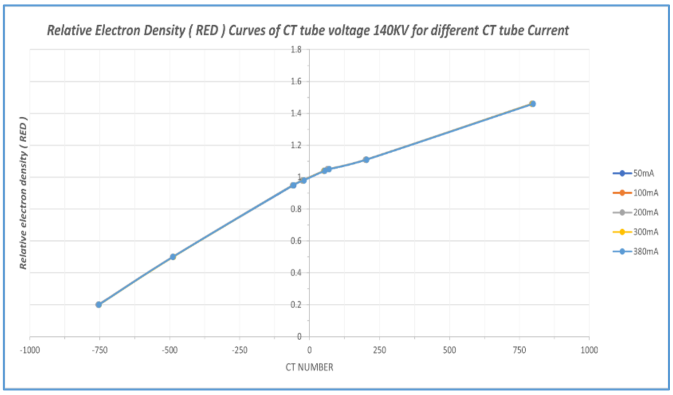


Figure 8. The effect of CT x-ray tube current (mA) variations on the relative electron density curves at tube voltage 140 kV.

Table 5 shows a larger different in ΔHU of 50 and 380mA tube current at constant tube voltage 80kV which a maximum value was also assigned for highest dense bone tissue equivalent and equal to (-147.1±107.2) and a minimum value (-0.3 ± 65.1).
Tables (6-8) shows the different in ΔHU of 50 and 380mA tube current at constant CT X-ray tube voltage (100, 120 and 140kV) respectively were very small and appear to be coincidently at the high CT tube voltage of 140 kV.

Table 5. The difference between the CT number or HU values HU^{50mA} and HU^{380mA} at CT x-ray tube current and voltage, 50 and 380mA and 80KV, respectively, for all tissue equivalent relative electron densities.

			RED - CT number at 80kv					
No.	**Tissue equivalent**	**RED**	HU^{50mA}	$\pm\sigma_A$	HU^{380mA}	$\pm\sigma_B$	ΔHU	$\pm\sigma_{A-B}$
1	LUNG (Inhale)	0.20	-718.3	69.5	-749.0	20.5	30.7	72.5
2	LUNG (Exhale)	0.50	-462.9	73.7	-479.5	26.0	16.6	78.1
3	ADIPOSE	0.95	-77.4	59.5	-77.1	26.4	-0.3	65.1
4	BREAST	0.98	-35.5	72.1	-37.0	28.0	1.5	77.3
5	MUSCLE	1.04	68.9	60.0	56.8	22.9	12.0	64.2
6	LIVER	1.05	108.8	75.9	75.0	23.4	33.8	79.4
7	BONE 200 mg/cc	1.11	266.5	91.9	307.9	39.0	-41.5	99.8
8	BONE 800 mg/cc	1.46	1063.3	99.7	1210.4	39.4	-147.1	107.2

Table.6 the difference between the CT number or HU values HU^{50mA} and HU^{380mA} at CT x-ray tube current and voltage, 50 and 380mA and 100KV, respectively, for all tissue equivalent relative electron densities.

			RED - CT number at 100kv					
No.	**Tissue equivalent**	**RED**	HU^{50mA}	$\pm\sigma_A$	HU^{380mA}	$\pm\sigma_B$	ΔHU	$\pm\sigma_{A-B}$
1	LUNG (Inhale)	0.20	-756.7	33.0	-750.9	13.1	-5.8	35.5
2	LUNG (Exhale)	0.50	-482.8	44.6	-486.4	11.8	3.6	46.1
3	ADIPOSE	0.95	-66.5	43.5	-68.4	14.1	2.0	45.7
4	BREAST	0.98	-31.9	49.3	-27.1	16.3	-4.7	51.9
5	MUSCLE	1.04	60.2	42.8	56.7	12.2	3.5	44.5
6	LIVER	1.05	69.1	45.8	71.8	15.0	-2.7	48.2
7	BONE 200 mg/cc	1.11	256.7	71.9	262.2	19.0	-5.5	74.4
8	BONE 800 mg/cc	1.46	1003.0	59.5	1008.3	19.4	-5.3	62.6

Table 9 represents the CT number or HU variation with respect to the variation of CT x-ray tube current (mA) (50, 100, 200, 300 and 380mA) of dense bone (RED = 1.46) at different CT X-ray tube voltage 80, 100, 120, 140 kV. The table show that the HU value is higher in low CT x-ray tube voltage 80kV compared with the high CT X-ray tube voltage 140kV for all CT tube currents investigated and the CT number value is remine the same at all CT tube voltage (100,120 and 140kV) at all tube currents except at 80kV the variation of CT number is observed, this mean that the low CT X-ray tube voltage impact the CT number because the photoelectric absorption is more dominant for high atomic number tissue such as dense bone.

Table 7. the difference between the CT number or HU values HU^{50mA} and HU^{380mA} at CT x-ray tube current and voltage, 50 and 380mA and 120KV, respectively, for all tissue equivalent relative electron densities.

			RED - CT number at 120kV					
No.	Tissue equivalent	RED	HU^{50mA}	$\pm\sigma_A$	HU^{380mA}	$\pm\sigma_B$	ΔHU	$\pm\sigma_{A-B}$
1	LUNG (Inhale)	0.20	-756.2	22.4	-750.5	10.9	-5.7	25.0
2	LUNG (Exhale)	0.50	-486.8	27.7	-487.3	8.6	0.5	29.0
3	ADIPOSE	0.95	-62.8	30.1	-61.9	9.8	-0.9	31.7
4	BREAST	0.98	-23.9	30.2	-24.3	11.7	0.4	32.4
5	MUSCLE	1.04	51.9	29.1	55.8	10.1	-3.9	30.8
6	LIVER	1.05	68.1	30.9	73.3	10.0	-5.2	32.4
7	BONE 200 mg/cc	1.11	225.4	36.8	228.1	12.1	-2.8	38.7
8	BONE 800 mg/cc	1.46	878.5	43.0	886.9	12.5	-8.4	44.8

Table 8. The difference between the CT number or HU values HU^{50mA} and HU^{380mA} at CT x-ray tube current and voltage, 50 and 380mA and 140KV, respectively, for all tissue equivalent relative electron densities.

			RED - CT number at 140KV					
No.	Tissue equivalent	RED	HU^{50mA}	$\pm\sigma_A$	HU^{380mA}	$\pm\sigma_B$	ΔHU	$\pm\sigma_{A-B}$
1	LUNG (Inhale)	0.20	-755.7	20.3	-752.7	7.3	-2.9	21.6
2	LUNG (Exhale)	0.50	-487.5	23.6	-487.9	8.0	0.4	24.9
3	ADIPOSE	0.95	-56.6	23.6	-58.3	7.6	1.7	24.8
4	BREAST	0.98	-23.4	24.3	-20.2	8.0	-3.3	25.5
5	MUSCLE	1.04	51.2	22.5	53.9	6.7	-2.7	23.5
6	LIVER	1.05	70.1	27.3	70.2	10.4	-0.1	29.2
7	BONE 200 mg/cc	1.11	204.2	27.8	203.7	9.3	0.5	29.3
8	BONE 800 mg/cc	1.46	799.3	35.1	799.1	10.8	0.2	36.7

Figure 9 illustrates the variation of CT number at different CT x-ray tube current and voltage, the figure shows that the CT number is change in low voltage 80kV.

Table 9. CT number or HU variation with respect to CT x-ray tube current (mA) of dense bone (RED = 1.46) for CT voltage 80, 100, 120, 140 kV.

Tube current (mA)	80 kV	100 kV	120 kV	140 kV
50	1063.3	1002.97	878.52	799.32
100	1166.65	1005.58	876.81	794.55
200	1190.87	1005.58	878.05	793.87
300	1204.9	1010.79	883.44	797.48
380	1210.41	1008.3	886.87	799.12

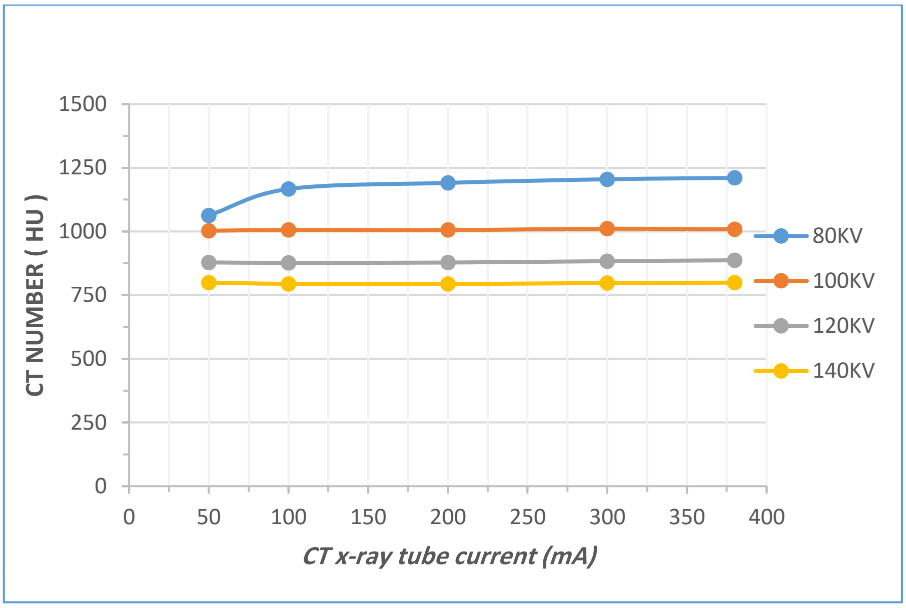


Figure 9. CT number or HU variation with respect to CT x-ray tube current (mA) of dense bone (RED = 1.46) for CT voltage 80, 100, 120, 140 kV.

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CONCLUSION

This study shows that the impact of variation of CT X-ray tube voltage and current on CT number -RED curve is seen more in high RED tissue such as dense bone special in low CT X-ray tube voltage the mean that it is important to measure the CT number -RED for all the CT simulation protocols use in clinic and consider this variation on radiotherapy treatment planning g system.

Conflict of interest. Nil

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البحث في تأثير تغيرات الجهد والتيار في الأنبوب على منحنيات تحويل رقم الأشعة المقطعية إلى الأشعة الحمراء لجهاز المسح المقطعي المحوسب للعلاج الإشعاعي

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المستخلص

محاكاة الأشعة المقطعية هي السلسلة الأولى في علاج العلاج الإشعاعي، حيث يتم التقاط صورة المريض بواسطة ماسح الأشعة المقطعية لتحديد الموقع الدقيق وكثافات أعضاء المريض في إحداثيات محددة تسمى بكسل، ولكل بكسل وحدة تسمى رقم الأشعة المقطعية أو وحدة هاونسفيلد (HU) والتي تمثل قيمة معامل التوهين الخطي لحزمة الأشعة السينية التي تتفاعل مع كل كثافة أنسجة مختلفة. من ناحية أخرى، كثافة الإلكترون (ED) هي عدد الإلكترونات الموجودة في أنسجة معينة ذات كثافة محددة، وتسمى النسبة بين كثافة إلكترون كل نسيج وكثافة إلكترون الماء بالكثافة الإلكترونية النسبية (RED)، ويجب قياس منحنى التحويل بين عدد CT و REDونقله إلى نظام تخطيط العلاج (TPS) والذي يُستخدم بعد ذلك في خوارزميات حساب الجرعة. تهدف هذه الدراسة إلى تقييم كيفية تأثير الاختلافات في جهد الأنبوب والتيار على منحنيات تحويل عدد CT إلى RED. باستخدام ماسح CT GE Lightspeed-RT وشبح CIRS (062M) مع إدخالات بكثافات أنسجة متنوعة، تم الحصول على الصور عند جهد أنبوبي 80 و100 و120 و140 كيلو فولت، عند إعدادات ثابتة لتيارات الأنبوب تتراوح من 50 إلى 380 مللي أمبير، والعكس صحيح. تم تسجيل متوسط عدد CT والانحراف المعياري لجميع الإدخالات في إعدادات مختلفة باستخدام برنامج Micro Dicom viewer. أثرت التغيرات في جهد الأنبوب عند تيار ثابت على المواد عالية الكثافة الحمراء (العظام الكثيفة)، بينما أثرت التغيرات في تيار الأنبوب عند جهد ثابت بشكل طفيف على منحنىCT-RED ، باستثناء الجهد المنخفض للأنبوب (80 كيلو فولت). بالنظر إلى الأدلة من هذه الدراسة وغيرها من الدراسات حول تأثير رقم CT على حساب الجرعة، فمن المستحسن مراعاة إعدادات الماسح الضوئي وجداول البحث CT-ED المحددة، وخاصة في السيناريوهات التي تنطوي على مواد عالية الكثافة، من أجل التخطيط الدقيق لعلاج العلاج الإشعاعي.

الكلمات المفتاحية. ماسح الأشعة المقطعية، رقم الأشعة المقطعية، وحدة هاونسفيلد، كثافة الإلكترون، كثافة الإلكترون النسبية.