CHAPTER 1

INTRODUCTION

1.1 Background and rationale

The use of pediatric Computed Tomography(CT), a valuable imaging tool, has been increasing rapidly. Because of the growth of CT and potential for increased radiation exposure to children undergoing these scans, pediatric CT has become a public health concern. There has been considerable interest in published works in radiology about radiation risk for CT examinations in children. Computed tomography contributes disproportionately to the collective radiation dose from diagnostic imaging. In UK, CT represents 4% of diagnostic radiology procedures and contributes to 40% of the collective dose.[1] In USA, 11% of diagnostic procedures are CT, which contributes to 67% of the collective dose. [2] Unlike in conventional radiology, excessive exposure (mAs and kVp) used during CT examinations do not necessarily result in decrease image quality.[3] Multislice CT has resulted in an increased complexity of scanning options that can lead to large patient radiation dose.[4]

The organs and tissue of children are more susceptible than those of adults to radiation–induced cancer.[5,6] A 1-year-old child is 10-15 times more likely than 50-year-old adult to develop a malignancy from the same radiation dose. [7] This is because of the increased radiosensitivity of tissue, especially early in life, the longer lifetime for radiation-related cancer to occur and higher organ dose [8,9]

As an example, compared with a 40-year old, the same radiation dose given to a neonate is several times more likely to produce a cancer over the child lifetime. Moreover, the same exposure parameters used for a child and adult will result in larger doses to the child. There is no need for these larger doses to children, and CT setting can be reduced significantly while maintaining diagnostic image quality. Therefore, children should not be scanned using adult CT exposure parameters. Currently, adjustments are not frequently made in the exposure parameters that determine the amount of radiation children receive from CT, resulting in a greater radiation dose than necessary.

The purpose of this study is to determine the methodology to reduce pediatric CT dose while maintaining image quality and to create a new brain protocol of exposure table in order to reduce pediatric CT dose.

1.2 Hypothesis

Pediatric radiation dose can be reduced to 20% from routine CT brain study while the image quality is clinically accepted.

1.3 Objective

1.3.1 To study the $CTDI_{vol}$ and DLP using the CT head protocol for dose reduction and maintain the image quality

1.3.2 To correlate the kVp, mAs on patient dose and image noise

1.4 Definition

Computed Tomography Dose Index (CTDI)	Equivalent to the dose value that would result if the absorbed radiation profile were entirely concentrated within a width equal to the nominal slice thickness. Accordingly, all contributions from the dose profile are summed (dose-length-product) and divided by the nominal slice thickness. Standard measurement of CTDI are Made at the centre and 1 cm below the surface of cylindrical Perspex phantom, 16 and 32 cm in diameter, respectively
Multislice Computed Tomography (MSCT)	CT scanner with a detector array consisting of more than single row of detectors that allows the simultaneous scanning of more than one slice.
Detector	The comment of a detector array which records X-ray quanta, either directly (gas detector) or indirectly (solid state detector), and converts them into electrical signals.
Noise	The point-to-point variation in the mage density that does not contain useful information. Defined as the percentage standard deviation of the CT numbers within a region of interest in the image of uniform substance (generally water), relative to the difference in CT numbers between water and air. Comprises quantum noise, electronic noise and reconstruction noise. In most CT images, quantum noise prevails
Scan protocol	Set of data such as tube potential, tube current scan time, slice thickness, reconstruction filter, window settings.