UNIVERSITI TEKNOLOGI MARA

THE EFFECT OF LEAD SHIELDING THICKNESS IN COMPUTED TOMOGRAPHY OF THE HEAD: A PHANTOM STUDY

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AUTHOR'S DECLARATION

I declare that the in tis thesis was carried out in accordance with the regulations of Unniversiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledge as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Under Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

CT of the head is the most requested examination in CT scan. However, the routine use of external shielding in CT imaging appears to be limited. It is because of concern that the application of external lead shielding may result in increased internal scatter and consequently lead to an increased dose to the radiosensitive organs (Palmer, 2008). The purpose of this study is to investigate the effect of different thickness of lead shielding in computed tomography (CT) examination of the head. This research is an experimental study using an anthropomorphic Rando phantom to imitate the patient. Different thickness of thyroid shield was applied which are 0.0 mm Pb, 0.5 mm Pb, 1.0 mm Pb and 1.5 mm Pb to protect thyroid gland from scattered radiation. Four thermoluminescent detector (TLD) chips were placed at surface of thyroid gland and 1 cm depth within thyroid tissue upon slice 10 and slice 11 of phantom. The Rando phantom was placed on the Siemens Somatom Definition Flash Dual Source 128-slice CT scanner table and a CT head protocol was performed. Then TLDs were read to measure the surface dose and absorbed dose of thyroid gland using different thickness of lead shield. The data collected was analysed to measure the significant different radiation dose with various different thickness of lead shielding using statistical one way ANOVA. This study provides evidence that the effectiveness of lead shielding varied with their thickness respectively corresponding to thyroid dose due to scattered radiation. The highest dose reduction was achieved by 1.5 mm Pb thickness which is 57.48% at the surface, 55.77% at 1 cm depth within thyroid tissue, followed by 1.0mmPb result in 56.69% at surface, 50% at 1 cm depth. The lowest dose reduction was achieved with 0.5 mm Pb is 52.76% at surface, 41.35% at 1 cm depth within thyroid tissue. This research suggested the application of thyroid shielding gives advantage especially to the paediatric patient and patients that require repetition CT examination because long term illness. This research has proven that reducing radiation dose to the patient because of scattered radiation by increasing the thickness of lead shielding can further decrease dose to radiosensitive organ outside the scanning area. As a result, the risks of inducing cancer will also be decreased.

TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1.1 RESEARCH BACKGROUND

Computed tomography (CT) has replaced the conventional tomography due to current technological development. Current multi-slice CT enables minimization of motion artefacts by providing short and fast scanning time; within a single breath hold while producing high resolution image. With these new innovations and new techniques as well as its widespread availability, it has increased in the number of CT scan being requested and the ability to perform new techniques such as CT angiography and virtual reality.

According to Shrimpton et al. (2005), the CT examination donates the major proportion of annual radiation dose to the UK population resultant from exposures in diagnostic X-rays. This was agreed by McLaughlin & Mooney (2003), which they stated that CT maintain to give a significant portion, of the collective radiation dose from all radiographic examinations which is up to 50%, and this number is likely to escalate further with the introduction of multi-slice CT. As compared to conventional planar X-ray imaging, CT has higher doses that have effect the level of internal and external radiation scattered to sites outside of the field of view. This is because CT scanners calculate x-ray attenuation properties of the body from various directions to construct cross-sectional images (McCollough et al., 2009). In addition, scattered radiation dose is typically low energy photons and it is increasingly common to mostly radiosensitive tissues like thyroid gland, breast and gonads.

The use of CT is exceedingly increased in current years and the additional radiation exposure has developed concerns regarding possible radiation-induced malignancies (Lee et. al., 2011). Therefore, this research investigate the effect of thyroid shielding designed to protect the thyroid and to measure the dose reduction achieved at the surface and 1 cm within thyroid gland using different thickness of lead shielding.