Pilot study: relative dose of the TLD, OSL and Radiochromic film applied in CT exams dosimetry

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At DDI/UNIFESP, the abdomen and chest CT exams correspond to 38% of the exams, becoming the focus of studies. The aim of this study is to assess the relative dose using TLDs, OSLs and RF for the evaluation of the dose distribution in the skin in abdomen CT exams. The simulation of the CT exam was performed in an anthropomorphic phantom, using a CT scanner Philips, Brilliance/64 and TLDs, OSLs and RF fixed along the sagittal axis of the phantom. The OSLs showed similar performance to the TLDs and RF shows low accuracy, resulting in an average value (0.927±0.022).

Keywords: computed tomography; abdomen; dosimetry

1. INTRODUCTION

In the last 10 years, it has been possible to see a great increase in the number of the Computed Tomography (CT) exams done in the medical diagnostic centers worldwide (1–3). The studies show that in 2010, only in the USA, more than 60 million CT exams were done on medical diagnostic centers (4). In Brazil, the National Register of Health Facilities (CNES, Cadastro Nacional de Estabelecimentos de Saúde) shows that there are 3312 CT scanners, 290 of them in São Paulo (5,6).

At Diagnostic Image Department (DDI) of the Federal University of São Paulo (UNIFESP), the abdomen and chest CT exams correspond to 38% of the exams becoming the focus of studies. For more than 30 years, the team of the Coordination of Medical Physics (COFIMED) of the DDI/UNIFESP, have been doing the control of the doses resulting from radiology exams, making use of instrumentation and simulators more suitable for each method of diagnostic imaging. For dosimetric evaluation on the patient measures, the CoFIMED uses the thermoluminescent dosimeter (TLD), Radiochromic film (RF) and most recently, the optically stimulated luminescence (OSL) technology (7,8). According to the literature, among all the above methods, the TLD is already well established in vivo on CT dosimetric application and the FR and OSL are still being studied (7–10).
2. OBJECTIVE

The aim of this pilot study is to assess the relative dose response on the volume CT dose index (CTDIvol), using three dosimetry systems, TLDs, OSLs and RF for the evaluation of the distribution of the dose in the skin in abdomen computed tomography exams.

3. METHODOLOGY

The study was conducted at DDI/UNIFESP, using a CT scanner Philips, Brilliance/64. The simulation of the CT exam was performed in an anthropomorphic phantom, RSD, ART Phantom subjected to routine exposure conditions for examinations of an adult abdomen, generated by 120kV, 265 mAs and 0.75 pitch in helical mode. Along the sagittal axis of the phantom surface, it was fixed 40 unities of TLD100, Harshaw (Figure 1) and 40 unities of OSLs, LANDAUER® dosimeters (Figure 2). In a second exposure, the same exam protocol was followed, having set 40 cm of the RF, XR-CT, Gafchromic® (Figure 3).

The CTDI volume was calculated according to the recommendations of the AAPM-96 using an acrylic simulator with a diameter of 32 cm and ionization chamber (IC) Victoreen pencil type, model 660 electrometer, probe 660-6 (12,13).

4. RESULTS

The CTDIvol result was 22.3±0.3 mGy. The figure 4 represents the distribution of the relative dose response of the CTDIvol to TLDs, OSLs and RF setting along the sagittal axis on the phantom’s surface. To each dosimetry system, the points were normalized as a function of the highest value obtained among the measurement results. The error bars indicated in the figure 4 show that the maximum error associated for each detector used was 5% to TLD and OSL and 3% to RF.
5. DISCUSSION AND CONCLUSION

The TLDs have been used for more than 30 years in radiological exams dosimetry. As it was expected, this study reassured the dosimetry qualities for CT doses evaluations (1). The OSLs showed a similar performance to the TLDs. In the literature, only a few publications mention the usage of OSL dosimetry in CT evaluations. However, this study demonstrates its viability and accuracy for this purpose. It also highlights the practicality of OSLs when compared to the TLDs processes, which require special heat care for this purpose. Despite being widely used in the dosimetry of the diagnostic imaging methods and therapies that use fluoroscopy, in the CT exams the RF application is still little explored (9,10). As seen in the figure 4, in this study RF shows low accuracy, resulting in an average value (0.927 + 0.022) on all the surface of the exposed area simulator.

7. REFERENCES

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