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Using CT scan to Detect Radiolucent Foreign Body (Glass): An Experimental Study

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Abstract

Usually on a hand or a foot X-ray which is done to detect a translucent foreign body (glass) do not work most of the time. Not to forget that ultrasound was used to detect some glass types before. The aim of this paper is to use CT scan and the color lookup table to detect the glass which was placed near a phantom.

Keywords: *Computed Tomography; Radiolucent Foreign Body; Color Table; Detection; Translucent*

Introduction

There are 66 types of glasses [1] and maybe more. Some of these glasses are undetectable on an X-ray, even though, many claim that all glasses are detectable on X-ray [1]. Others disagree, and they claim that only 10% of the radiographs give positive feedback, but it can detect 85% of the radiopaque glass [2]. There are many factors that affect the detectability of the glass: 1-Type of glass, 2-Density of the glass, 3-Location of the glass, 4-Size of the glass, and 5-The percentage of lead and silica in the glass. Even though, others claim that led and silica percentagesin glass are not important factors [3, 4].

Other papers claim that only glass that is bigger than 2 mm will be detected on radiographs [5,6,7]. In another paper, the authors claim all glass is radiopaque [3].

Another authorclaims that all glass is detectable on CT scan [8]. The density of the glass varies between 500- 1900 HU with an average of 1200 [8]. Any dense fragment that is > 0.01 mm is detectable on CT scan [7]. Ultrasound can detect glass, but it will cause reverberation artifact thatappears as a posterior acoustic shadowing [7]. On MRIglass is seen on all sequences, but artifact is present too, so MRI should not be considered [8].

The Experiment and The Result

In this paper, 2 pieces of glass were taken one from a white cup and one from a transparent glass. The pieces were smashed into small pieces (as small as possible). Both types of glass were put on a phantom and scanned by a CT scanner. The colors lookup table were used with both images (of the two glasses) to see if it will make them distinct from the phantom. The 1st glass size is 0.09 mm and the 2nd glass size is 0.05 mm. The first glass (from the white cup) was radiopaque and easily to be identified see (Fig.1). The second glass (from the water glass) was radiolucent and its texture is not distinct from the phantom texture see (Fig.2). To conclude the experiment, the glass type and size are very important to find the foreign body in the patient. As well, the colors lookup table did not provide any help. The size 0.05 mm were seen on the CT scan, but the low density of the glass made it impossible to differentiate the glass texture from the phantom texture. Therefore, X- ray and CT scan can't show all types of glass. As well, ultrasound might provide a solution. The amount of lead and silica used in the glass increase then the density/Hounsfield unit increase then it appears as a radiopaque material in the scan.

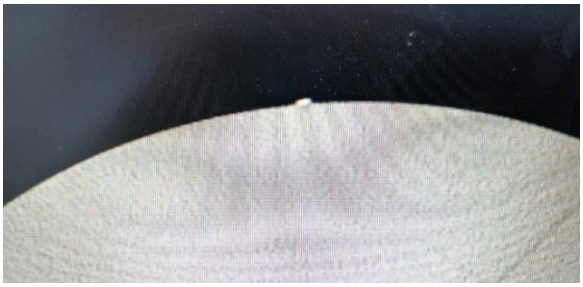

Fig 1: A white glass with size of 0.09 mm. The glass appears dense (white) compared to the phantom below it.

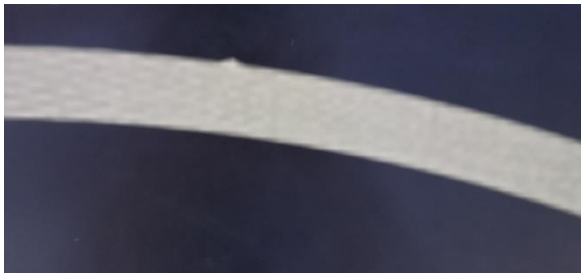

Fig 2: A transparent glass with size of 0.05 mm. The glass appears to have the same density compared to the phantom.

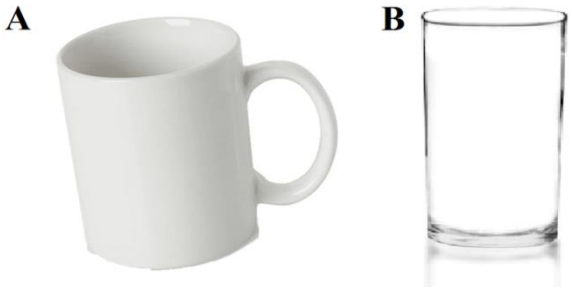

Fig 3. A-the cup which the 1st type of glass was taken from it. B-the cup which the 2nd type of glass was taken from it.

Discussion

According to many papers, all glasses are visible on CT scan [1,3,8], which proven in this paper to be wrong. A simple test using a transparent glass was placed on a phantom and scanned by a CT scanner did not show different density for the glass from the phantom. Ultrasound is superior to CT scan in imaging glass which show acoustic shadowing [4], meanwhile, CT scan can't show some types of glasses as found in this paper. The glass depth in the body will determine the ability of ultrasound ability to locate the glass.

Conclusion

Ultrasound is superior to CT scanner in imaging foreign body (i.e., glass) and a comparison study must be done. Some authors claim that CT scan can show any type of glass which is wrong statement and exaggeration. Color lookup table did not help in detecting the glass.

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