

## Improving lens irradiation in CT brain scans: a multi-CT scanner audit

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### Abstract

#### *Aim*

To reduce the proportion of non-contrast CT brain scans that irradiate eye lenses, including those performed on the sliding-gantry CT scanner.

#### *Methods*

Fifty non-contrast CT brain scans were audited for lens exclusion. Scans performed for trauma or orbital indications were excluded. A radiographer re-education period followed, emphasising the incorporation of gantry tilt and encouraging patients to adopt a chin-tuck position. The audit was then repeated.

#### *Results*

There was an improvement in lens exclusion from 10% to 48% ( $P<0.001$ ). Lens exclusion on the sliding gantry CT improved from 3% to 48% ( $P<0.001$ ).

#### *Discussion*

Despite the limited gantry tilt of the sliding-gantry CT system, a chin-tuck position and/or head-tilt cushion can result in lens exclusion at a rate comparable to a non-sliding gantry CT system.

## Introduction

Cataracts are a major cause of blindness worldwide. Ionising radiation exposure to the lens is a risk factor for cataract development<sup>1,2</sup>. To reduce lens irradiation during computed tomography (CT) brain scans, European guidelines advise implementing a CT gantry tilt of 10-12° above the orbitomeatal line<sup>3</sup>.

SOMATOM Definition AS+ (Siemens) is a sliding-gantry CT scanner, currently in use in the Emergency Department at University Hospital Limerick (UHL), Ireland. It is presently the only sliding-gantry scanner in Ireland. It has a more limited gantry tilt than a conventional scanner, which could reduce the radiographers ability to exclude the lens, and may increase lens irradiation.

The aim of this audit is to reduce the proportion of non-contrast CT brain scans, including those performed on the sliding-gantry CT, that directly expose the lenses to ionising radiation.

## Methods

This is a retrospective audit of non-contrast CT brain scans performed in patients aged between 16 and 80 years, in UHL. Two CT scanners were included: SOMATOM Definition Edge (Siemens) and SOMATOM Definition AS+ (Siemens). Scans performed for trauma or orbital indications were excluded. The first fifty scans that met the inclusion criteria over a 1-week period in April 2022 were audited for lens exclusion by the study author, under supervision of a consultant radiologist. Results were compared to the Royal College of Radiologists (RCR) audit standard, which targets 100% lens exclusion<sup>4</sup>. The audit was approved by the hospital audit committee.

Audit results were presented at a departmental meeting. A 2-week radiographer re-education period followed, emphasising the incorporation of gantry tilt and encouraging patients to adopt a chin-tuck position and/or use a head-tilt cushion, where possible. The audit was repeated over a 1-week period in June 2022.

Chi-square tests were used to assess for independence of categorical variables. Independent samples t-tests were used to compare means across groups. These were considered statistically significant if  $P < 0.05$ .

## Results

Table 1 describes patient demographics and rates of lens exclusion in both audits. In the initial audit, 50 scans were included out of 76 reviewed for inclusion. In the repeat audit, 50 were included out

of 81 reviewed. Lens exclusion in non-contrast CT brain scans significantly improved from 10% to 48% ( $P<0.001$ ). On the SOMATOM Definition Edge CT-scanner, lens exclusion increased from 21% to 47% ( $P=0.09$ ), while on the sliding-gantry SOMATOM Definition AS+ CT-scanner, it increased from 3% to 48% ( $P<0.001$ ).

## Discussion

While there was a significant improvement in lens exclusion, it did not reach the RCR audit standard. Several reasons contributed to this. There was a variation in radiographer practice in applying the changes, which is not unique to our institution<sup>5</sup>. Additionally, some elderly patients and those with reduced cervical mobility were unable to position as instructed. Lens exclusion improved in patients aged 70 years or older, from 6% to 27% ( $P=0.09$ ). However, this post-intervention rate of 27% remained significantly lower than the post-intervention rate of 57% for patients below 70 years ( $P=0.04$ ).

The SOMATOM Definition AS+ CT scanner has a sliding gantry, enabling the scanner to move between a scanning room and trauma room, separated by a shielded retractable partition door. This is beneficial in emergency and trauma scenarios as the CT scanner can be temporarily moved out of the way to enable treatment or resuscitation. It also reduces the number of patient transfers. The gantry tilt on this system is limited to a maximum of 15 degrees, compared to 30 degrees on conventional CT scanners such as the SOMATOM Definition Edge. Thus, radiographers may not be able to tilt the gantry sufficiently away from the lens. The initial rate of lens exclusion on the sliding-gantry CT was 3%, compared to 21% on the regular CT ( $P=0.04$ ). By encouraging a chin-tuck position and/or using a head cushion, where appropriate, the rate of lens exclusion with the sliding-gantry scanner significantly improved to 48% ( $P<0.001$ ) and this rate was similar to the post-intervention rate of 47% with the conventional scanner. This suggests the more restricted gantry tilt is not a limiting factor in lens exclusion.

UHL, as with many healthcare institutions, has seen increased staff turnover exacerbated by the COVID-19 pandemic. It is difficult to maintain audit standards in hospital departments with increased staff turnover<sup>6</sup>. Previous audits in our institution demonstrated a range of lens exclusion rates from 5% to 34%. To improve upon the recently achieved rate of 48%, the department will address factors such as limited radiographer adherence, and conduct regular re-education sessions and further audit cycles.

## Declaration of conflict of interest:

None declared.

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**Table 1.** Patient demographics and lens exclusion compared in both audits.

	Initial audit	Repeat audit	
<b>Total</b>	n = 50	n = 50	
<b>Gender (%)</b>			
Female	28/50 (56%)	26/50 (52%)	<i>P</i> =0.7
<b>Age (years)</b>			
Mean age	60	54	<i>P</i> =0.1
Range	17, 80	16, 79	
<b>Lens exclusion overall (%)</b>			
Both lenses excluded	5/50 (10%)	24/50 (48%)	
One lens excluded	2/50 (4%)	4/50 (8%)	

No lens excluded	43/50 (86%)	22/50 (44%)	<i>P</i> <0.001
<b>Exclusion of both lenses (%)</b>			
< 70 years old	4/32 (13%)	20/35 (57%)	<i>P</i> <0.001
≥ 70 years old	1/18 (6%)	4/15 (27%)	<i>P</i> =0.09
<b>Exclusion of both lenses on each CT-scanner (%)</b>			
SOMATOM Definition Edge	4/19 (21%)	9/19 (47%)	<i>P</i> =0.09
SOMATOM Definition AS+	1/31 (3%)	15/31 (48%)	<i>P</i> <0.001