Thyroid Shielding in Radiographic Procedures: Fit vs Dose

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Abstract
The thyroid gland is a vital hormone gland that plays a major role in the metabolism, growth and development of the human body. The thyroid gland is among the most radiosensitive organs. The usage of thyroid shields by healthcare professionals is an essential precaution for radiation protection. The purpose of this experiment was to determine if thyroid shield fit affects radiation dose received to the thyroid gland. The fit was recorded by measuring from the jugular notch or location of thyroid, to the inside of the thyroid shield. Qualitative data was collected by interviewing staff technologists on whether or not they thought thyroid shield fit was important.
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The thyroid gland is a vital hormone gland that plays a major role in the metabolism, growth and development of the human body. The thyroid is among the most radiosensitive organs. The usage of thyroid shields by healthcare professionals is an essential precaution for radiation protection. The purpose of this experiment was to determine if thyroid shield fit affects radiation dose received to the thyroid gland. The fit was recorded by measuring from the jugular notch or location of thyroid, to the thyroid shields inner lining or side closest to skin. Qualitative data was collected by interviewing staff technologists on whether or not they thought thyroid shield fit was important.

Data Collected:

<table>
<thead>
<tr>
<th>Distance</th>
<th>Dosimeter Readings</th>
<th>Percent Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid shield 1 cm gap</td>
<td>0.872 mR</td>
<td>Baseline</td>
</tr>
<tr>
<td>Thyroid shield 1 in. gap</td>
<td>0.950 mR</td>
<td>8.94%</td>
</tr>
<tr>
<td>Thyroid shield 1.5 in. gap</td>
<td>0.981 mR</td>
<td>3.27%</td>
</tr>
<tr>
<td>Thyroid shield 2 in. gap</td>
<td>1.452 mR</td>
<td>48.01%</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Distance</th>
<th>Dosimeter Readings</th>
<th>Percent Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thyroid shield 1 cm gap</td>
<td>0.239 mR</td>
<td>Baseline</td>
</tr>
<tr>
<td>Thyroid shield 1 in. gap</td>
<td>0.252 mR</td>
<td>5.44%</td>
</tr>
<tr>
<td>Thyroid shield 1.5 in. gap</td>
<td>0.283 mR</td>
<td>12.30%</td>
</tr>
<tr>
<td>Thyroid shield 2 in. gap</td>
<td>0.684 mR</td>
<td>141.69%</td>
</tr>
</tbody>
</table>

Table 1: Dosimeter Readings @ 40” SID

Table 2: Dosimeter Readings @ 72” SID

Data Analysis:

Table 1: When comparing a thyroid shield gap of 1cm to a 1 in. gap there was only a 0.076mR increase in dose. There was little difference between 1in. gap and 1.5 in. gap with a dose increase of 0.031mR. However, when the gap was increased to 2 in. there was a 0.580 mR increase in dose from a 1 cm gap. This data demonstrates that dose will begin to significantly increase when the thyroid shield gap is 2 in. or greater.

Table 2: Series was conducted using a 72 in. SID. When comparing a 1cm gap to a 1 in. gap, there was a 0.039mR increase in dose. When changing from a 1 in. gap to a 1.5 in. gap, there was a 0.031 mR increase in dose. The largest dose increase of 0.445mR was seen when comparing the 1 cm gap to the 2 in. gap. A notable increase in dose of 0.401mR was seen between the 1.5 cm gap and the 2 in. gap.

Figure 1: This line graph includes the data collected from a 40 in. SID and also from a 72 in. SID. It is seen that when the thyroid shield has a 1.5 in. gap or greater, the radiation dose received in this area of the body is noticeably higher. A gap of 1.5 in. or smaller resulted in negligible difference in dose. The results were the same for both 40 in. SID and 72 in. SID.

Recommendations

Limitations were possible, inaccuracy of the dosimeter and the fit of the thyroid shield not being an exact science. Normally, you would not direct the x-ray tube directly at the person wearing the lead, but for the purposes of this experiment we needed the dosimeter to pick up enough dose to be measurable. This may make our dose measurements higher than they would be in a real world setting. Further experiments that could have been performed are simulating surgery with a C-arm and recording the dose the radiologic technologist would get with different fits of the thyroid shield. Also, we could have simulated a patient holding at child scenario and the dose the parent receives with different fits of the thyroid shield.

Our recommendation is more education be given to radiologic technologists to always wear their thyroid shield comfortably snug at a distance from the neck of 1.5 inches or less. To keep technologists from receiving more dose than needed they practice as low as reasonably achievable (ALARA), minimize time exposed, maximize distance from radiation, and use lead shielding. Some suggestions to better protect technologists is to wear leaded glasses, have bigger rooms to allow for more distance, and stand behind the C-arm instead of directly next to it to minimize scatter radiation.

Conclusions

Overall, our research and experiment has suggested that donning a thyroid shield and wearing it comfortably snug, or with a 1.5 in. gap or less between the neck and thyroid shield, is a good way of protecting medical radiation workers from excessive amounts of thyroid radiation exposure. This is of particular importance because the thyroid is a very radiosensitive organ, which means it’s very susceptible to cancer.

References