Excess Rotations prior to and following a helical CT run

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Background

- During commissioning work on a Toshiba Aquilion multislice CT we noticed discrepancies between axial and helical dosimetry.
- Understanding this action with a pencil CT chamber was initially difficult to interpret
- Direct measurement of the excess radiation on film was essential.

Initial Findings

- The Toshiba scanner appeared to perform two complete rotations before and after the planned volume or “range” as given on the operators console.
- This was verified by Toshiba.

Example – standard abdomen

- Range 280.5mm
- Total scan time 10.5s
- Rotation time 0.5s
- Couch speed 16.5mm/rotation

- The number of rotations calculated from the range/speed

  =280.5/16.5 = 17
- The rotations calculated by the number of individual times divided by the total time = 10.5/0.5 = 21

Example – standard abdomen

- Irradiated volume = 21 x 16.5 = 346.5mm
- Excess irradiation = 346.5 – 280.5 = 66mm

- The axial length taken up by a single rotation is
  = effective slice width x pitch/multislice setting
  = 12 x (5.5/4)
  = 16.5mm
- The extra axial length irradiated = 16.5 x 4 = 66mm

- An excess 3.3cm of tissue is irradiated at each end of the volume

Excess irradiation

- The actual excess dose will depend on the specific parameters set.
- However, our findings show that this increases the dose by approximately 20%
- e.g. 66/280.5 x 100 = 23.5%
- A standard head scan with a range of 209 and an actual scanned length of 253mm has an excess dose of 44/209 x 100 = 21%

Clinical Implications

- More ‘standard’ scans are performed with volume scanning
- There will therefore be irradiation of organs outside the planned volume e.g. the lens of the eye prior to a standard head run, or the extension into the abdomen after a chest scan.
- This is made worse by the increased effective slice width provided by multislice scanners.

Future work

- Other scanners showed a variety of pre-and post-volume rotation.
- We need to understand exactly what is being described by the start and end of a scan to ensure proper effective dose estimations and patient protection.
- We need to ensure that the users are aware of these problems and how to manage them.