

Setting Up Local Dose Reference Limits For Orthopaedic Bone SPECT-CT

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Objective

SPECT-CT (Hybrid imaging) increase diagnostic accuracy by providing both functional and anatomical images of the body. There is considerable national variation in the CT radiation dose while performing SPECT-CT procedures.

National dose reference limits (NDRLs) have been proposed, but these do not account for different body parts scanned. The purpose of this audit is to set local diagnostic reference limits (LDRLs) for diagnostic quality CT examinations.

Methods

Data from the CT dose record, body region and dose range for SPECT-CT procedures for patients who had undergone SPECT-CT scans were obtained from PACs. All imaging was performed according to the department standard protocol.

Only procedures which have 10 or more patient's studies have been used to set LDRLs. The mean and standard deviation of dose length product (DLPs) and Computed tomography dose index CTDIvol for different body parts was calculated, and the LDRL investigation level was set as 20% above the mean. Results were compared with national diagnostic references levels (NDRLs).

Results

128 patients were included in the audit over a six month period.

The mean whole-body SPECT-CT CTDIvol was 7% less than the whole-body PET-CT CT dose proposed by the NDRL.

Proposed changes

- Local DRLs audits to be carried out at least annually.
- If an audit reveals that DRL value for any procedure exceeds investigations threshold consistently, an investigation and corrective action plan will be taken to determine the possible reason and should be documented.
- If both DLP and CTDIvol are too high then scan parameters will be checked.
- Image quality must never be compromised while any changes made.

Acknowledgements

We would like to thank Anton Paramithas and James Hubber from St Georges Hospital Medical Physics Department for their help with this poster.

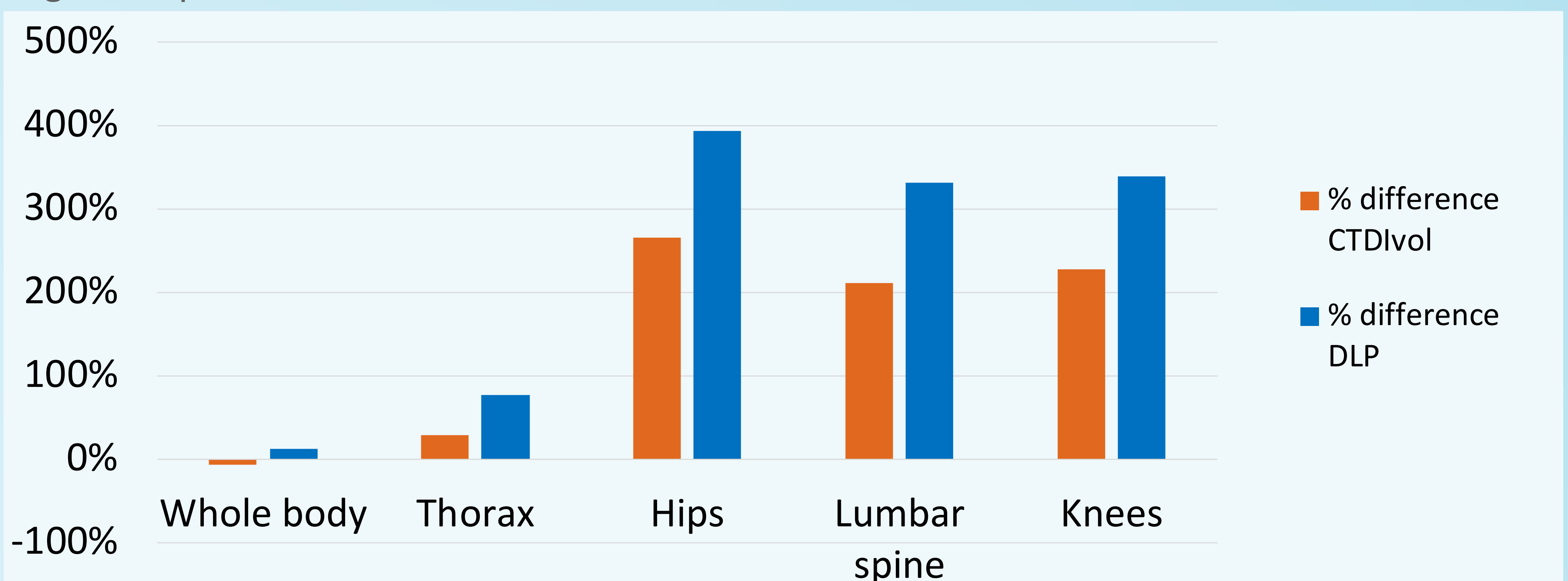
Table 1. Average of CTDIvol and DLP for CT body parts

SPECT-CT Body parts	Number of studies	Average of Scan Length (mm)	Average of CTDIvol (mGy)	Average of DLP (mGy-cm)	Investigation threshold CTDIvol	Investigation threshold DLP
Whole body	41	1099	4.0	451	4.8	542
Thorax	13	394	6.3	265	7.6	318
Hips	11	400	17.9	741	21.5	889
Lumbar spine	11	400	15.3	648	18.3	777
Knees	29	523	16.1	659	19.3	791

Table 2. Comparison of local CTDIvol and DLP with NDRLs

SPECT-CT Body parts	Average of CTDIvol (mGy)	Proposed CTDIvol (mGy)	% difference CTDIvol	Average of DLP (mGy-cm)	Proposed DLP (mGy cm)	% difference DLP
Whole body	4.0	4.3	-7%	451	400	13%
Thorax	6.3	4.9	29%	265	150	77%
Hips	17.9	4.9	265%	741	150	394%
Lumbar spine	15.3	4.9	212%	648	150	332%
Knees	16.1	4.9	228%	659	150	339%

Fig 1. Comparison of local CTDIvol and DLP with NDRLs



We need to set up LDRLs because:

- Diagnostic quality CT is performed for orthopaedics
- Different joints require different scanning parameters
- Effective dose depends on body part scanned

Conclusions

LDRLs were set for several examinations and changes to CT acquisition parameters were made to reduce the dose. When it comes to orthopaedic CT, optimisation of CT for each body part needs to be considered when determining DRLs.

DRLs for standard CT investigations cannot be applied to hybrid imaging because of differences in the clinical purpose and scan range.

References

Iball GR1, Bebbington NA, Burniston M, Edyvean S, Fraser L, Julyan P, Parkar N, Wood T. A national survey of computed tomography doses in hybrid PET-CT and SPECT-CT examinations in the UK. Nucl Med Commun. 2017 Jun;38(6):459-470.

In relation to this presentation, I declare that there are no conflicts of interest.

Table 3. Proposed Local DRLs

SPECT-CT Body Parts	Local DRLs (mGy)
Whole Body	4.8
Thorax	7.6
Hips	21.5
Lumbar spine	18.3
Knees	19.3