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Radiation Protection of Patients in Cranial Computed Tomography (Gantry Tilt)

Recommendation by the German Commission on Radiological
Protection

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**Strahlenschutz des Patienten bei CT-Untersuchungen des Schädels
(Gantrykipfung)**

Empfehlung der Strahlenschutzkommission

This translation is for informational purposes only, and is not a substitute for the official recommendation. The original version of the recommendation, published on www.ssk.de, is the only definitive and official version.

CONTENTS

1 Introduction4

2 Context.....4

3 Recommendations5

4 References.....6

1 Introduction

Until now, the occurrence of eye lens opacities (cataracts) has been regarded as a deterministic radiation risk, characterised by an assumed threshold dose of around 2 Gy for short-term (acute) radiation exposure. This is reflected in a specific dose limit for the lens of 150 mSv/year for occupational exposure.

New findings (SSK 2009) suggest, however, that the threshold dose should be set at a much lower level, if indeed a threshold dose exists at all, and that a risk of cataract formation already arises below 100 mSv. Particular attention must therefore be paid to the eye lens as an organ with a high level of radiation sensitivity. The Guidelines issued by the German Medical Association (*Bundesärztekammer*) (BÄK 2007) require the eye lens to be protected from radiation by means of gantry tilt and adjustment of the scan length: *“Whenever possible, directly adjacent radiation-sensitive organs, such as the lenses, should not be exposed directly to radiation during a CCT. With spiral scans, it is important to take account of the automatic extension of the scan length beyond the planned image boundaries (“overranging”), especially when using multi-detector scanners (MDCT) with 16 or more slices being scanned simultaneously. It is essential to consider that some CCT equipment does not allow any gantry tilt options; this can be compensated for with a slight adjustment (= inclination) of the head position.”* (BÄK 2007)

This element of the BÄK Guidelines is regularly monitored by the medical authorities of the German federal states (*Bundesländer*) within the framework of quality assurance (Section 17 of the X-Ray Ordinance (*Röntgenverordnung – RöV*)).

2 Context

CT scanning of the cranium (cranial computed tomography – CCT) is the cross-sectional imaging diagnosis technique most commonly used in the majority of hospitals and medical practices. As the primary investigation choice for the detection of brain injuries (e.g. intercranial pressure, trauma, ischemia, haemorrhage), it accounts for between 30 % and 80 % of all CT scans performed, depending on the X-ray unit’s clinical priorities. With local tissue doses of around 50 mGy (diagnostic reference value $\text{CTDI}_{\text{Vol}} = 65 \text{ mGy}$ (BfS 2010)), it is also the CT scanning technique which results in the highest local doses.

Due to the development of new MDCT scanners with wide detector arrays, the eye lens increasingly lies within the direct exposure range as a result of overranging and overbeaming. Some new CT scanners (e.g. dual source scanners, scanners with more than 200 detector rows, PET-CT) no longer allow tilting of the gantry.

Whereas indirect lens exposure in the adjacent scattered radiation field amounts to around 10 % compared with direct exposure in the scan area, protection measures such as overlaying of protectors and partial ventral beam blanking only reduce dose by approximately 50 % (Keil et al. 2008).

High-contrast CT scans which include the orbits, such as CT scans of the paranasal sinuses in cases of sinusitis, are performed with much lower exposures (diagnostic reference value $\text{CTDI}_{\text{Vol}} = 9 \text{ mGy}$ (BfS 2010)).

It is also important to consider that some surgical navigation systems do not work when lens protectors are used due to the image artifacts in the near field of the protectors. The surface of the skin cannot be correctly detected. As a result, an additional CT scan may in some cases be required for intra-operative navigation.

3 Recommendations

The Commission on Radiological Protection addresses the following recommendations to the users of CT scans:

1. CCT scans should, in accordance with the BÄK Guidelines, always be performed with gantry tilt or corresponding head position so that primary exposure of the lens of the eye is avoided.
2. In case of more than one CT scanner being available, scans should be scheduled so that CCT scans are performed on equipment where gantry tilting is available.
3. If MDCT spiral technology is used, the eye lens dose should be reduced by minimising overranging through appropriate reduction of collimation and pitch while maintaining the mAs product.
4. On equipment where overranging cannot be minimised, it is important to determine whether it is possible to apply scan protocols without spiral technology (sequential scans).
5. Personnel performing CT scans should request patients CCT scans to look at their feet during scanning (distance between the lens and the scan area).
6. If the positioning of the eye lenses in the scan area cannot be avoided, protectors and/or ventral beam blanking or other appropriate measures should be used in order to provide an equal level of protection for the eye lens and reduce lens exposure.
7. CT personnel must be trained in measures to reduce lens exposure, and evidence of this training must be provided. In particular, the significance of overranging / overbeaming and the possible need for dose reduction measures in this context must be conveyed.
8. To implement the above recommendations, the specific measures to protect the lens of the eye must be integrated into existing standard operating procedures (SOP).

The Commission on Radiological Protection addresses the following recommendations to the manufacturers of CT scanning equipment:

1. Technical options to avoid overranging must be made available.
2. MDCT scanners should display the exposed area, including overranging and overbeaming, in addition to the scan area.

4 References

- BÄK 2007 Leitlinie der Bundesärztekammer zur Qualitätssicherung in der Computertomographie, gemäß Beschluss des Vorstandes der Bundesärztekammer vom 23. November 2007, <http://www.bundesaerztekammer.de/downloads/LeitCT2007Korr-1.pdf>
- BfS 2010 Bundesamt für Strahlenschutz (BfS): Bekanntmachung der aktualisierten diagnostischen Referenzwerte für diagnostische und interventionelle Röntgenuntersuchungen vom 22. Juni 2010, <http://www.bfs.de/de/ion/medizin/referenzwerte02.pdf>
- Keil et al. 2008 Keil, B., Wulff, J., Schmitt, R., Auvanis, D., Danova, D., Heverhagen, J., Fiebich, M., Madsack, B., Leppek, R., Klose, K.J., Zink, C.: Schutz der Augenlinse in der Computertomografie – Dosisevaluation an einem antropomorphen Phantom mittels Thermolumineszenzdosimetrie und Monte-Carlo-Simulationen, RÖFo 180(12), 1047-53, 2008
- SSK 2009 Strahlenschutzkommission (SSK): Strahleninduzierte Katarakte, Empfehlung der Strahlenschutzkommission, verabschiedet auf der 234. Sitzung der SSK am 14.05.2009, BAnz Nr. 180a vom 27.11.2009