

Ultra low dose dual source high-pitch computed tomography of the paranasal sinus: diagnostic sensitivity and radiation dose

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Authors: B. Schell, S. Potente, S. Zangos, R. Bauer, J. M. Kerl, T. J. Vogl, M. G. Mack; Frankfurt a. Main/DE
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Purpose

Inflammatory diseases of the paranasal sinus have a relatively high prevalence in younger patients and often need antibiotic treatment, sometimes even surgical intervention. Today's gold standard for diagnostic imaging of inflammatory diseases of the paranasal sinus is computed tomography. However, it is important to emphasize radiation sensitive tissue like eye lenses and thyroid gland, that they get radiated by direct or scattered x-rays during the examination. Since this patient collective is mostly of lower age and repetitive examinations might be done during follow up examination, an increased balance in dosage of routine protocols is required. The purpose of this study is to evaluate diagnostic sensitivity and radiation dose of an ultra low dose dual-source CT technique.

Methods and Materials

Paranasal sinuses of 14 cadaveric heads were independently evaluated by 2 readers using a modern dual source CT with lowest reasonable dosage in high-pitch mode (100kV, 10mAs, collimation: 0.6mm, pitch value = 3.0).

The following relevant radiological criteria regarding a possible inflammation of each sinus were focused on: sinusoidal fluid, circumferential or polypoid mucosal swelling within a paranasal sinus (Fig. 1). Furthermore the mastoid cells were evaluated regarding their pneumatization.

Additionally the head part (Slice 1-25) of an anthropomorphic Alderson-Rando phantom was equipped with thermoluminescent detectors (TLD) to measure radiation exposure. The TLD were irradiated 5 times in order to achieve a significant dosage and the measured result was divided by 5 to achieve the average boreholder dosage.

Images for this section:



Fig. 1: Axial reformation (slice thickness: 3mm) with an edge enhancing kernel in bone window. The left maxillary sinus shows a fluid level.

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Results

Diagnostic accuracy regarding sinusoidal fluid, nasal septum deviation and mucosal swelling was 100%. Mastoid fluid was detected in 76% and 92% respectively (Fig. 2).

The phantom measurements regarding radiation found 0.67 mGy for the left eye lens, 0.61 mGy for the right lens and 0.12 (resulting in an average exposure of 0.64 mGy) respectively 0.05 mGy for the superior and inferior portions of the thyroid gland, resulting in an average exposure of 0.085 mGy (Fig. 3).

Images for this section:

	Total pathologies (n)	Reader 1	Reader 2
Sinusoid cavities with fluid levels	50	50	50
Sinusoid cavities with tissue swelling	4	4	4
Nasal septum deviation	8	8	8
Concha bullosa	6	4 (67%)	6
Aberrant carotid artery in sphenoidal sinus	2	2	2
Mastoid with fluid levels	13	10 (76%)	12 (92%)
Skull fracture	2	0 (0%)	2

Fig. 2: Type and total number of pathologies found in the autopsy and positive findings of two readers by using the proposed ultra low dose CT technique. Gold standard was the conducted autopsy.

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TLD placements	Measured dosage (mGy)	Phantom slice level
Cerebrum parietal	0.43	1
Cerebrum frontal	0.56	
Calvaria median	0.35	2
Cerebrum left	0.43	
Cerebrum right	0.46	
Cerebrum frontal	0.56	
Cerebellum median	0.38	3
Cerebrum frontal	0.46	
Eye lens left	0.67	
Eye lens right	0.61	
Cerebellum median	0.34	4
Thyroid gland (upper part)	0.12	8
Thyroid gland (lower part)	0.05	9

Fig. 3: Measured dosage of the proposed dual source high-pitch CT examination technique by using the head part of an Alderson phantom equipped with Thermoluminescent Dosimeters. The radiation sensitive thyroid gland being hit by scattered radiation is exposed by 0.12 respectively 0.05mGy. Eye lenses were irradiated with 0.67 resp. 0.61 mGy.

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Conclusion

Our results indicate that the proposed ultra low dose dual source protocol has sufficient diagnostic validity while causing only minimal radiation exposure to the patient. Mucosal swellings as well as fluid levels within the paranasal sinus were nearly completely identified by both readers. Regarding detection of rhinosinusitis the sensitivity of even discrete findings was 100%, implying a safe use for daily clinical practice.

References

Abul-Kasim K, Strombeck A, Sahlstrand-Johnson P. Low-dose computed tomography of the paranasal sinuses: radiation doses and reliability analysis. *Am J Otolaryngol* 2009;"Electronic publication".

Hagtvedt T, Aalokken TM, Notthellen J, et al. A new low-dose CT examination compared with standard-dose CT in the diagnosis of acute sinusitis. *Eur Radiol* 2003;**13**:976-980.

Schell B, Bauer RW, Lehnert T, et al. Low-dose computed tomography of the paranasal sinus and facial skull using a high-pitch dual-source system--first clinical results. *Eur Radiol* 2011;**21**:107-12.