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Computerized tomography of the orbit

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The role of computerized tomography in the diagnosis of orbital diseases is presented. The problems of radiation and protection are particularly pointed out as it is believed that the investigation-related radiation dose may be high enough to produce a cataract.

Key words: orbital diseases; tomography, x-ray computed

Introduction

Computerized tomography (CT) is a computer-quided X-ray imaging method. Owing to its good resolution, thin sections and short exposure time CT is suitable for imaging of the orbit as well as of other formations of the skull base.

The bony structure of the orbit and its contents is examined using axial and coronal (transverse) planes.[1] An image in other plane can be reconstructed by means of a computer in the same way as e.g. an image in the sagittal or frontal plane can be reconstructed from axial sections. Apart from the fact that the resolution of such images is generally of a lower quality, also the measurements of absorption values are not sufficiently accurate. Besides, absorption measurements on a CT with poor resolution are also of inferior quality. A better reconstruction of images can be obtained by partly overlapping sections, however, this approach requires a greater number of sections to be done, which results in a higher exposure of the patient to radiation. In order to calculate the volume of e.g. fatty tissue in the orbit a number of sequential parallel sections is needed. Adverse effects of x-rays are particularly evident on the eye lens where they may give rise to a cataract. Critical absorption doses able to cause this condition range between 2-15 Gy (Gray),[2] depending on the age of the patient (1 Gy is a unit used in dosimetry, denoting absorbed energy per mass unit of matter, i. e. 1J/kg; 1 Gy = 100 rad).

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Radiation dose per eye lens

Radiation dose to the eye lens received by the patient on CT of the orbit is in direct correlation with

- number of sections,
- thickness of sections
- mAs product
- direction of sections with respect to the eye lens (Figures 1, 2, 3, 4, 5).

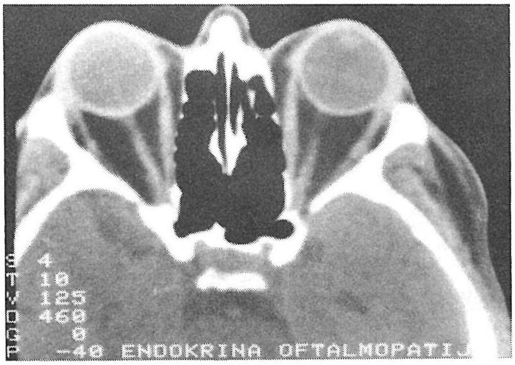

Figure 1. Small exophthalmus and enlargement of the extraocular muscles and orbital fat as well (magnification).

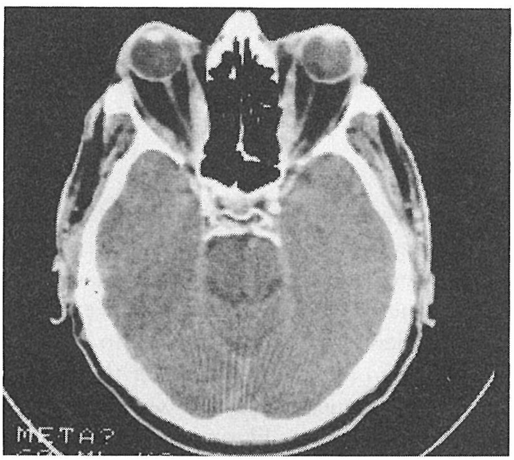

Figure 2. Large exophthalmus and huge enlargement of orbital fat, and increase in the size of medial muscles.

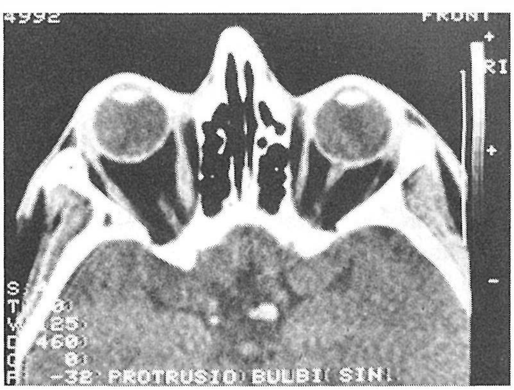

Figure 3. Exophthalmus of the left eye and enlargement of the medial extraocular muscle.

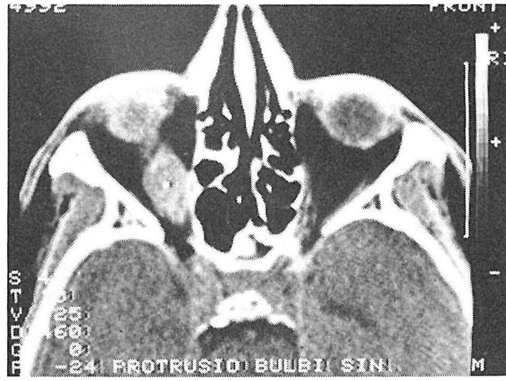

Figure 4. Retrobulbar tumor of the left orbit.

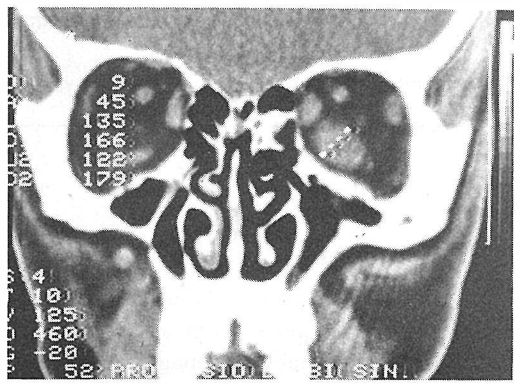

Figure 5. Retrobulbar tumor between medial and inferior extraocular muscles. Both muscles are changed (coronal projection with magnification).

The highest radiation dose to the eye lens is received when the eyeball is in the direct beam of X-rays. Total dose received in an examination of the orbit using a sequence of closely parallel thin axial sections is 20 mGy, whereas the dose with coronary sections amounts to 47 mGy. In the section thickness of 2 mm we use 780 mAs product, in 4 mm 460, and in 8 mm 230. Thus the total dose to the eye lens received during examination of the orbit using 4 mm sections is only 20 mGy, whereas with 2 mm sections the dose amounts to 52 mGy. Thin sections provide a more accurate information and a better image owing to the elimination of data pertinent to the adjoining structures, though in this case a much higher number of sections is needed for imaging of the same structure.[3]

Conclusion

In CT examination of the orbit as low a number of maximum thin target sections as possible should be made by means of a machine that can produce a good-resolution image in a very short exposure time. Nevertheless, magnetic resonance should be used preferably for examination of the orbit, whenever available. In this way the risk of a cataract and associated with that further damage of the eye, which has already been affected by different conditions such as e.g. endocrine ophthalmology, can be significantly reduced.

References

1. Jacobs L, Weisberg LA, Kinkel WR. *Computer Tomography of the Orbit and Sella Turcica.* Raven Press Books, 1980.
2. Neufang KFR, Zanella TE, Ewen K. Radiation Doses to the Eye in Computed Tomography of the Orbit and the Petrous Bone. *Europ J Radiol* 1987; **7:** 203–5.
3. Newton TH, Potts DG. Radiology of the Skull and Brain. *Technical Aspects of Computed Tomography,* The C. V. Mosby company, 1981; **5:** 4228–58.