Optimized Examination Technique Reduces Examination Time for Children with Retinoblastoma by Half

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Introduction
Retinoblastoma is the most common (intraocular) eye tumor of childhood with an incidence of approx. one affected child per 18,000 live births. If the tumor is detected and treated at an early stage, more than 95% of patients will survive [1]. Tumors that are present in one eye only are referred to as unilateral retinoblastoma. Approx. 2/3 to 3/4 of affected children experience unilateral retinoblastoma [3]. When the tumors are present in both eyes, they are referred to as bilateral retinoblastoma. Because most patients are children, the examination usually has to be performed under general anesthesia. The most common symptoms include leukocoria, strabismus, glaucoma and loss of vision. In 30% of cases both eyes are affected. The diagnosis is usually made on the basis of a clinical examination, ophthalmoscopy and ultrasound. Magnetic resonance imaging* (MRI) is the procedure of choice for visualizing the local ophthalmic findings, the extent of the tumor and possible associated brain changes, which is essential for treatment planning. An MRI examination of retinoblastoma poses a major challenge even for the most experienced examiner. Suspected retinoblastoma requires far more than a standard examination of the orbita. Producing high resolution images with optimized sequences and MR hardware is crucial for treatment planning and ultimately for its success. As Technologists we play a significant role in this process.

Examination
Apart from examining the orbits, the brain also needs to be visualized. The MRI examination can provide information on whether there is extraocular tumor growth and/or whether there is a tumor of the bones or brain tissue. Because the patients are children, the examination is performed mostly under general anesthesia, and special care is required before, during and after the examination. Since in a third of cases both orbits are affected, it is advisable to examine both eyes. Previously we used to examine each eye separately. This used to take about two hours. Now with the new technique the whole examination including both orbits takes approximately 57 minutes. In the following we would like to explain our examination technique, now used routinely, which allows the brain and both eyes to be simultaneously visualized at high resolution in a considerably shorter examination time.

*MR scanning has not been established as safe for imaging fetuses and infants under two years of age. The responsible physician must evaluate the benefit of the MRI examination in comparison to other imaging procedures.

References
1 http://www.uk-essen.de/augenklinik/retinoblastom.html
2 http://www.onmeda.de/krankheiten/retinoblastom-definition-1779-2.html
3 http://www.uk-essen.de/augenklinik/retinoblastom.html
4 http://www.kinderkrebsinfo.de/e9031/e10591/e77086/e63970/index_ger.html
5 http://www.krebsgesellschaft.de/pat_ka_retinoblastom_defin,108207.html
6 http://www.dr-gumpert.de/html/retinoblastom.html
# Examination protocol

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<tr>
<th>Sequence</th>
<th>Slice orientation</th>
<th>TR</th>
<th>TE</th>
<th>Slice thickness</th>
<th>FOV</th>
<th>Base resolution</th>
<th>Phase resolution</th>
<th>iPAT</th>
<th>Acquisition time min:sec</th>
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<td></td>
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<td>T2 TSE complete skull</td>
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<td>106</td>
<td>4 mm</td>
<td>200</td>
<td>512</td>
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<td>5,27</td>
<td>0.7 mm</td>
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<td>256</td>
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<td>16</td>
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</tr>
<tr>
<td>MPRAGE</td>
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<td>2070</td>
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<td>1 mm</td>
<td>195</td>
<td>384</td>
<td>75</td>
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<tr>
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<td>sagittal</td>
<td>569</td>
<td>23</td>
<td>2 mm</td>
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<td>512</td>
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Examination planning

1A Axial planning.

1B Sagittal planning.
Technical details

We use two small loop coils from Siemens Healthcare, Erlangen, and place these on the eyes. Both coils are attached securely and connected (Figs. 2B, C).

2A (A) MAGNETOM Aera at University Hospital Essen. (B, C) Patient positioning with 2 small loop coils.
Examination results

Unilateral retinoblastoma

3A Transversal T1-weighted SpinEcho (SE), 2 mm, native.
3B Transversal T2-weighted Turbo SpinEcho (TSE), 2 mm.
3C Transversal T1-weighted SE, 2 mm, post contrast, fatsat.
3D Sagittal T1-weighted SE, 2 mm, post contrast, fatsat.

Bilateral retinoblastoma

4A Transversal T1-weighted SE, 2 mm, native.
4B Transversal T2-weighted TSE, 2 mm.
4C Transversal T1-weighted SE, 2 mm, post contrast, fatsat.
4D Sagittal T1-weighted SE, 2 mm, post contrast, fatsat.
Conclusion

In summary, high resolution images can be obtained using two loop coils connected in parallel and a small field-of-view of approximately 100 mm. This is crucial for a confident diagnosis of extraocular tumor growth as well as the assessment of tumor growth, spread of the cancer and whether other anatomical structures have been affected. As both eyes are examined at the same time, examination time can be shortened by half, thus greatly reducing the time the patient is under general anesthesia.

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Following right-side enucleation.

5A Transversal T1-weighted SE, 2 mm, native.

5B Transversal T2-weighted TSE, 2 mm.

5C Transversal T1-weighted SE, 2 mm, post contrast, fatsat.