

**MRI in Pediatric Pulmonary Disease –  
Steady State Free Precession Projection (SSFP) MRI as an Alternative to the Pediatric Chest Roentgenogram ?  
Presentation of a Clinical Study**

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**Introduction:** Magnetic Resonance Imaging (MRI) is an excellent radiation free method for evaluating thoracic anatomy and disease in children. The parenchyma itself, however, is difficult to investigate due to the low proton density and the extremely short T2\* induced by the large local magnetic field gradients at the alveol-air boundary. The long acquisition time of the MRI investigation leads to motion artifacts which severely compromise lung imaging. Therefore in most pediatric departments plain chest film is still the first step in evaluating pulmonary and thoracic disease even though pediatric patients are more sensitive to radiation than adults. SSFP is a new projection MRI-technique which results in a very short acquisition time and a high signal-to-noise ratio (SNR). The purpose of our study is to evaluate the clinical value of this technique as an alternative to the conventional chest x-ray.

**Methods:** After approval by the local ethics committee 50 pediatric patients from 2 ½-40 years (median age 15 years) were selected by the pathologic findings on plain chest film. (Pneumonia n=7, cystic fibrosis (CF) n=14, congenital heart disease n=15, thoracic lymphoma n=2, alveolar proteinosis n=1, pneumothorax n=2, cystic lung malformation n=1, others n=8). After informed consent (parents and child if possible) the patients were investigated by a newly designed true FISP sequence (TR=6.4ms, TE=3.2ms, matrix=256x256, FOV=450 mm, projection slab up to 300 mm, flip-angle=90°, acquisition time=1.6s, 1 acquisition, T1/T2 image contrast) in a 0.2 Tesla MRI-unit (Magnetom Open, Siemens, Erlangen, Germany) without cardiac or respiratory gating and without any special hardware [1,2]. A one-slice image (50-150 mm) and a three-slice image (20-80 mm, no gap) were obtained from each patient. Median time between x-ray and MRI study was < 1day (0-8 days). Signal-to-noise ratios were calculated for lung parenchyma and pathologic findings. Finally, comparison with conventional chest film was performed and data were statistically evaluated (Wilcoxon test).

**Results:** Acquisition time was 1,6 s for 1-slice investigations, 4.9 s for 3-slice investigations. Breathhold was accomplished by all even by oxygen-dependent CF patients. Median SNR for lung parenchyma was 13 (± 12) for the 1-slice MRI and 7 (± 5) for the middle section of the 3-slice MRI. Circumscribed pathologies (n=20) showed a significant increase in SNR of 38 (± 27) and 24 (±17) respectively (p < 0.0001). Mean projection slab was 150 mm (50-250) for the 1-slice MRI and 50 mm (20-80) for the 3-slice images. All pathologic findings on chest x-ray were clearly detected on the corresponding MRI-images.

No blurring or motion artifacts occurred only in some studies with the thick slab technique a small intensity variation was observed presumably due to dephasing effects in projection direction.

Good correlation was seen in cardiothoracic diameter (correlation coefficient = 0,84). All radiological pneumonic infiltrations were also diagnosed securely on the corresponding MRI images (figure 1). Clinical improvement correlated well with follow-up MRI investigations. Pleural and pericardial effusions which were not securely diagnosed on chest x-ray were detected by means of the MRI image (figure 1). Interstitial changes as seen in cystic fibrosis could also be shown in MRI (figure 2).

**Conclusions:** The presented projection MRI-technique is a promising alternative to the conventional chest x-ray in pediatric pulmonary disease.

**References:**

- [1] A.Oppelt, R.Graumann, et.al.  
FISP - A New Fast Imaging Sequence  
Electromedica, 54, 15 (1986)
- [2] M.Deimling, O. Heid  
Magnetization Prepared True FISP  
SMRM, 1994 p. 495



Figure 1: Pneumonia and minimal pleural effusion (arrow) in a 15 year-old male



Figure 2: Chronic changes in CF in a 30 year-old male