Case Series: Utilization of the Pediatric 16 Coil for 1.5T and 3T Systems

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Introduction
At our institution we have a high rate of pediatric cases which can be both difficult and challenging. As a University Hospital, we perform pediatric imaging for a wide range of indications including the brain, spine, heart, abdomen, pelvis and whole-body and the imaging of children can involve either general anesthesia or the feed and wrap technique. In all cases, fast and robust workflows for high-resolution imaging are required. In this article, we would like to share our experiences with the Pediatric 16 coil on both 1.5T and 3T to demonstrate what it can help achieve. We had acquired the coils in December 2015 for our 1.5T MAGNETOM Aera and 3T MAGNETOM Skyra. This gives us the opportunity to easily setup our program either with anesthesia or the feed and wrap. It simplifies the setup of our busy daily program and helps us to avoid any dead- or delay time that may arise from these cases.

The Pediatric 16 is a 16-channel receive coil with 16 integrated pre-amplifiers for head and neck imaging of new-borns and infants up to 18 months of age. There are 13 channels for head imaging and 3 channels for the neck, and these channels can be used independently. The coil is equipped with DirectConnect technology and it connects directly into the scanner table with no connecting cables. Other special features include a recess in the anterior coil for easy positioning of intubation tubes, and a 4 cm aperture at the top of the coil for better ventilation. As a Tim4G Matrix coil, the Pediatric 16 can be combined flexibly with other coils including the Spine, Body, Flex and Special Purpose coils for whole CNS and whole-body imaging and this opens many opportunities for the imaging of infants and small children.

While this coil is intended for infants from 0-18 months, we have experienced a few cases where children did not fit. For instance, a 1-year-old infant with hydrocephalus may not fit due to the size of the head. Conversely, a 20-month-old infant may fit perfectly. Obviously, infants vary in size and this needs to be checked in each case.

In our experience, compared to the Head/Neck 20 this dedicated pediatric coil provides much better performance at the same scan times due to the fact that the coil fits more closely to the heads of small infants. Cases 1-4 illustrate the fast and high-resolution imaging we can achieve with this coil across infants of varying ages.

Along with Pediatric 16 comes a cradle with two straps and cushions to help with fixation. This cradle was designed to enable the preparation of infants away from the scanner and to provide safe and efficient transport of the infant to the scanner. This cradle has proven itself to be a true workflow enhancer at our institution, especially for our feed and wrap examinations. Firstly, we can plan our exam in good time with other departments so the patient can come to us in a position ready for examination. We do not lose time preparing the baby at the scanner, and we find that most babies lie much more still when everything is ready. All we need to do at our department is a final check for safety aspects (pul oximetry, ECG etc.). For children requiring only brain or brain and spine scans, the cradle can be slid easily into the Pediatric 16 coil (without the need to remove the anterior part) and the patient can be put into the scanner without further coil management. If the baby requires whole-body imaging, the Body coil can be easily placed on the child. This cradle has high edges, which means that coils can be put directly on these edges for stabilization, rather than laying them directly on top of the child. There are also cases where smaller coils would be needed, such as the small Flex coil. We can position this inside the edges along with cushions. This is much easier compared to the situation where the patient is lying directly on the table with positioning sandbags along the sides. Our use of the cradle has enabled faster, robust and more comfortable examinations for the child so much so that we use the cradle even for patients requiring only body or cardiac imaging.

Cases 5 and 6 are illustrations of our patients who have undergone liver and cardiac examinations where the cradle has helped with the workflow.

1 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 over other imaging procedures.
Case 1

10-day-old infant 1 with left-sided seizure and suspicion of cerebral infarct. The patient weight was approximately 3 kg. Imaging was performed on a 3T MAGNETOM Skyra with the Pediatric 16 coil, as a feed and wrap procedure. There were no findings.

(1A) T2w TSE transversal, voxel 0.49 x 0.49 x 3 mm, TA: 2 min 12 sec.
(1B) T1w TSE transversal, voxel 0.74 x 0.74 x 3 mm, TA: 2 min 32 sec.
(1C) T2w TSE coronal, voxel 0.49 x 0.49 x 3 mm, TA: 2 min 12 sec.
(1D) Diffusion-weighted imaging (DWI) RESOLVE, b-value 1000 (acquired b0, b500 and b1000), voxel 1.5 x 1.5 x 4 mm, TA: 2 min 30 sec.
(1E) DWI apparent diffusion coefficient (ADC) map.
(1F) T1w SPACE IR coronal, voxel 1.17 x 1.17 x 0.9 mm, TA: 2 min 16 sec.
(1G) Time-of-flight (TOF) transversal, voxel 0.5 x 0.5 x 0.5 mm, TA: 3 min 42 sec.
(1H) TOF maximum intensity projection (MIP).
(1I) Phase contrast (PC) MIP sagittal, voxel 1.3 x 1 x 1 mm, TA: 4 min 37 sec.
Case 2

1-year-old male infant with increasing frequency of epileptic seizures, hemiparesis, fever and a cold. The patient’s weight is approximately 10 kg. Imaging was performed on a 3T MAGNETOM Skyra with the Pediatric 16 in combination with the Spine 32. The exam was performed under general anesthesia. The report for this patient indicated slight hypomyelination with a possible small syrinx in the distal medulla.

(2A) T1w 3D MPRAGE acquired in sagittal plane without contrast medium, voxel 1 x 1 x 1 mm, TA: 5 min 5 sec.
(2B) T1w 3D MPRAGE 1 mm coronal multi-planar reconstruction (MPR) without contrast.
(2C) T1w 3D MPRAGE 1 mm transversal MPR without contrast.
(2D) T1w 3D MPRAGE 1 mm acquired in sagittal plane with contrast medium, voxel 1 x 1 x 1 mm, TA: 5 min 5 sec.
(2E) T1w 3D MPRAGE 1 mm coronal MPR with contrast medium.
(2F) T1w 3D MPRAGE 1 mm transversal MPR with contrast medium.
(2G) T2w 3D SPACE FLAIR acquired in sagittal plane, voxel 1 x 1 x 1 mm, TA: 5 min 24 sec.
(2H) T2w 3D SPACE FLAIR 1 mm coronal MPR.
(2I) T2w 3D SPACE FLAIR 1 mm transversal MPR.
(3A) T2w TSE transversal, voxel 0.2 x 0.2 x 2 mm, TA: 4 min 32 sec.
(3B) T2w TSE coronal, voxel 0.2 x 0.2 x 2 mm, TA: 4 min 32 sec.
(3C) Susceptibility-weighted imaging (SWI) transversal miniP image, voxel 0.6 x 0.5 x 1.4 mm, TA: 5 min.
(3D) SWI Phase image.
(3E) DWI RESOLVE, b-value 1000 (acquired b0, b500 and b1000), voxel 1.5 x 1.5 x 4 mm, TA: 4 min 21 sec.
(3F) DWI ADC map.

(4A) T2w TSE sagittal, voxel 0.9 x 0.8 x 2 mm, TA: 2 min 58 sec.
(4B) T1w TSE sagittal, voxel 1 x 0.9 x 2 mm, TA: 3 min 42 sec.
(4C) T2w TSE transversal, voxel 0.8 x 0.6 x 3 mm, TA: 3 min 10 sec
Case 3
A 2-week-old infant with increased head circumference with suspicion of hydrocephalus. The patient’s weight is approximately 4.8 kg. Imaging was performed on the 1.5T MAGNETOM Aera with the Pediatric 16, as a feed and wrap procedure. The report indicated that this infant might have BESS (benign enlargement of the subarachnoid spaces in infancy).

(5A) T2w TSE transversal, voxel 0.4 x 0.4 x 4 mm, TA: 4 min 32 sec.
(5B) T1w TSE transversal, voxel 0.7 x 0.7 x 4 mm, TA: 3 min 48 sec.
(5C) T2w TSE coronal, voxel 0.4 x 0.4 x 4 mm, TA: 4 min 32 sec.
(5D) T1w 3D MPRAGE, voxel 1 x 1 x 1 mm, TA: 4 min 23 sec.
(5E) T1w 3D MPRAGE 1 mm transversal MPR.
(5F) T1w 3D MPRAGE 1 mm coronal MPR.
(5G) T2w TSE sagittal, voxel 0.5 x 0.4 x 3 mm, TA: 4 min 19 sec.
(5H) CISS sagittal, voxel 0.9 x 0.9 x 0.7 mm, TA: 4 min 8 sec.
(5I) T2w 3D SPACE, voxel 1 x 1 x 1 mm, TA: 4 min 3 sec.
Case 4

2-year-old-child with neuroblastoma of the neck. The patient has been imaged previously with both ultrasound and MR, but has not yet been treated. The patient’s weight was approximately 6.8 kg. Imaging was performed on a 3T MAGNETOM Skyra with the Pediatric 16 in combination with Spine 32. The examination was performed under general anesthesia. The report indicated that central parts of the tumor show less contrast-enhancement compared to an earlier MRI exam, and tumor measurements remain the same.

(6A) T2w TSE Dixon water only, voxel 0.7 x 0.7 x 2.5 mm, TA: 3 min 6 sec.
(6B) T2w TSE Dixon water only, voxel 0.7 x 0.7 x 2.5 mm, TA: 3 min 9 sec.
(6C) T2w TSE Dixon water only, voxel 0.7 x 0.7 x 2.5 mm, TA: 3 min 9 sec.
(6D) T1w TSE Dixon water only, voxel 0.5 x 0.5 x 2.5 mm, TA: 4 min 40 sec precontrast.
(6E) T1w TSE Dixon water only, voxel 0.5 x 0.5 x 2.5 mm, TA: 4 min 40 sec postcontrast.
(6F) T1w TSE Dixon water only, voxel 0.5 x 0.5 x 2.5 mm, TA: 4 min 23 sec postcontrast.

Conclusion

If your site does many pediatric cases, I can definitely recommend this coil. For the head imaging of neonates and small children, the size of the coil provides higher signal-to-noise ratio (SNR) which allows us to achieve better imaging in short scan times. After we started using this coil, we had many more successful feed and wrap exams thanks to the cradle itself. Given the complexity and sensitivity of an MR examination for small infants and children, it makes clinical sense to use a coil that is dedicated to their care. With the significant number of such exams that we perform at our site, the workflow benefits are, for us, innumerable.

Acknowledgements

I would like to thank my good friend and MR mentor Rolf Svendsmark. My fellow colleagues at work, and my friend Lisa Chuah.

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References / further reading

Case 5
A 3-week-old infant with Trisomy 21 with a focal lesion seen on the left liver lobe with ultrasound and suspicion of malignancy. The patient’s weight was approximately 5 kg. The examination was performed on a 1.5T MAGNETOM Aera with the Spine 32 in combination with the Flex 4 Small. The cradle of the Pediatric 16 coil was used for the preparation, transport and positioning of the patient for imaging. The examination was performed as a feed and wrap procedure. The report indicated the presence of a hypervascular tumor in the left liver lobe that could be a hemangioma.

(7A) T2w HASTE coronal respiratory triggering, voxel 1.3 x 1.3 x 3.5 mm, TA: 44 sec.
(7B) T2w HASTE transversal respiratory triggering, voxel 1.3 x 1.3 x 3.5 mm, TA: 58 sec.
(7C) T2w 3D SPACE with SPAIR fatsat and respiratory triggering, voxel 1 x 1 x 1 mm, TA: approx. 5 min 20 sec.
(7D) T1w StarVIBE precontrast, voxel 1 x 1 x 3 mm, TA: 2 min 20 sec.
(7E-I) Multiple T1w StarVIBE images captured continuously after injection of contrast medium.

(8A) DWI free-breathing b50
(8B) b400
(8C) b800
(8D) ADC map voxel 2 x 2 x 3 mm, TA: 3 min.
Case 6

A 2-year-old child with congenital heart disease. The patient has DORV (double outlet right ventricle) and TGA (transposition of the great arteries). The patient was referred with the question of possible hypertrophy and for pre-operative imaging. The patient’s weight was approximately 10 kg. The examination was performed on a 1.5T MAGNETOM Aera with the Spine 32 in combination with the Flex 4 Small. The cradle of the Pediatric 16 coil was used for the preparation, transport and positioning of the patient for imaging. The examination was performed under general anesthesia. The report confirmed the known clinical conditions with no change to anatomy. No hypertrophy was found.

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