MRI of the Fetal Skeleton: Tips for Sequence Parameters and Post-Processing Protocol

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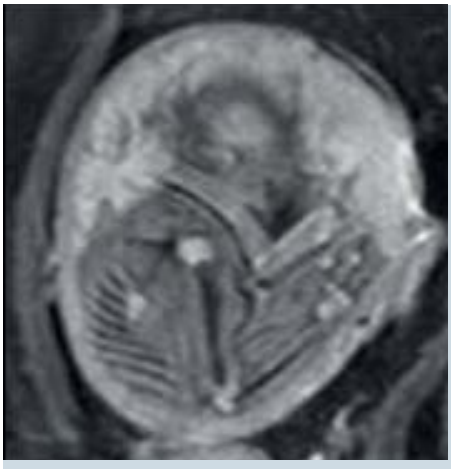
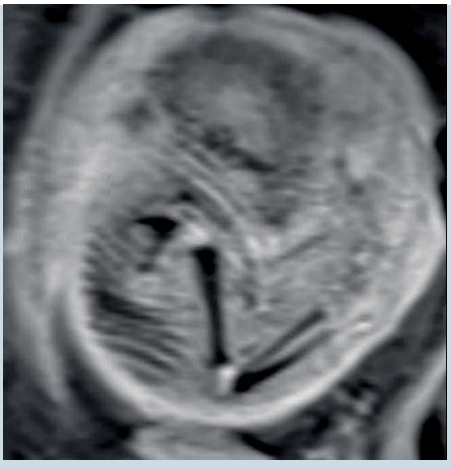
Fetal[1] skeletal dysplasias are a complex group of developmental bone and cartilage disorders, which usually result from mutated genes. Symptoms can include abnormal growth of the limbs, absence of a limb, duplication of fingers or toes and many other deformities.
In general, three main technologies are used to obtain images within the uterus during pregnancy: ultrasonography (US), magnetic resonance imaging (MRI) and computed tomography (CT) [1, 4–6]. US is currently the primary method for fetal assessment during pregnancy because it is patient friendly, useful, cost-effective and considered to be safe. When US yields equivocal results, MRI is generally used, because it provides additional information about fetal[1] abnormalities and conditions in situations where US cannot provide high-quality images [6].
Ultrafast T2-weighted sequences (HASTE) are commonly used in fetal[1] MRI [2, 3, 6]. For further investigation of the fetal[1] skeleton currently 2D echo planar imaging (EPI) sequences are used for the visualization of the skeleton [3]. One limitation of this 2D sequence is that it delivers only images in the acquisition plane. 3D sequences have the advantage that images can be reconstructed in every desired plane. Also multiplanar reconstructions (MPR), minimum intensity projections (MIP) and volume rendering (VRT) can be created that help for the visualization and identification of the skeleton. For this reason a T2*-weighted 3D TurboFLASH sequence can be applied.
The main interest here is to show in two cases the MRI sequence parameters and post-processing protocol of the fetal[1] skeleton.

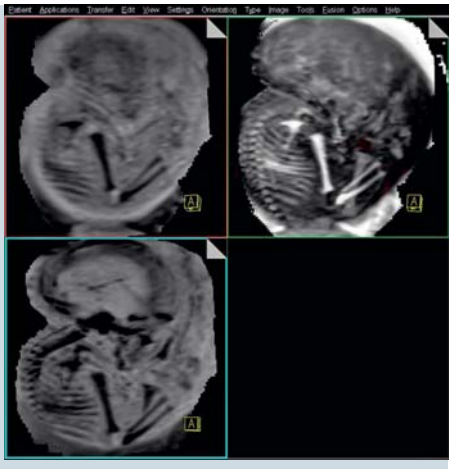
[1] MR scanning has not been established as safe for imaging fetuses and infants under two years of age. The responsible physician must evaluate the benefit of the MRI examination in comparison to other imaging procedures.



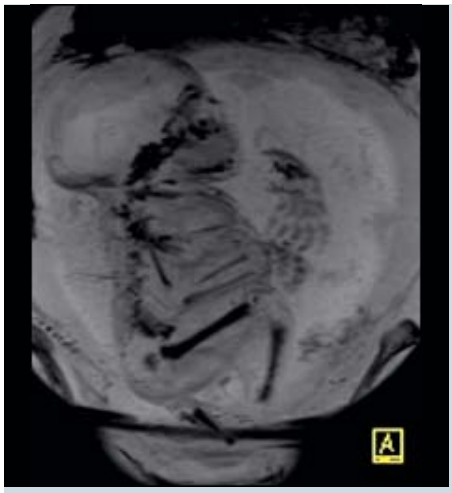
1A 27-week-old fetus[1] in oligohydramnios. Sagittal oblique T2*-weighted echo planar image: The skeleton appears hypointense and the cartilage as hyperintense.



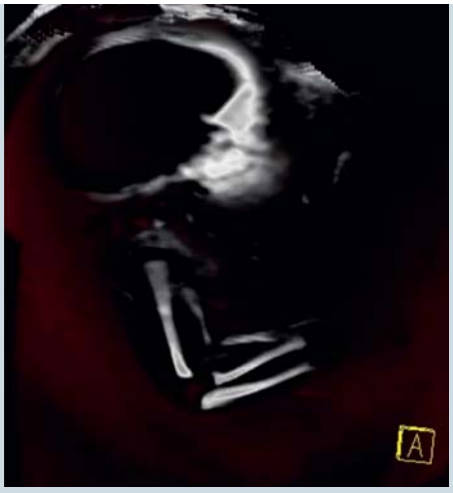
1B Same fetus[1]. T2*-weighted 3D FLASH sequence. The bones appear hypointense whereas the cartilage appears hyperintense (less than in the EPI sequence) to the surrounding tissue.



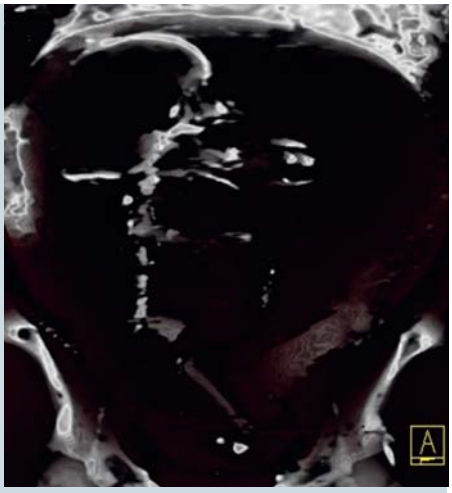
1C Same fetus[1]. Upper left: MPR. Upper right: VRT. Lower left: MinIP.



2A 35-week-old fetus[1] with platispondilia. T2*-weighted 3D FLASH sequence (sagittal view). The femur and tibia can be clearly identified.



2B T2*-weighted 3D FLASH sequence. The humerus, ulna and radius can be clearly identified.



2C T2*-weighted 3D FLASH sequence. Note the platispondilia of vertebral body.

MRI protocol

The MRI was performed on the 1.5T MAGNETOM Aera (software version *syngo* MR D11) using the 18-channel body phase array.

Sequence	epse2d	fl3d
Type	epi	gre
Scan time	27 seg	21 seg
Res [mm³]	1.7 x 1.7 x 3.5	2 x 2 x 2
TR [ms]	2280	11.1
TE [ms]	46	9.53
FOV [mm]	300	380
Slices	24	60
Gap	0	0
Average	8	1
Concatenations	1	1
Flip angle	90	4
Slice thickness	3.5	2
Bandwidth	1050	475
ETL	46	n/a

References

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