Accelerating MRI to Treat Rare Birth Conditions

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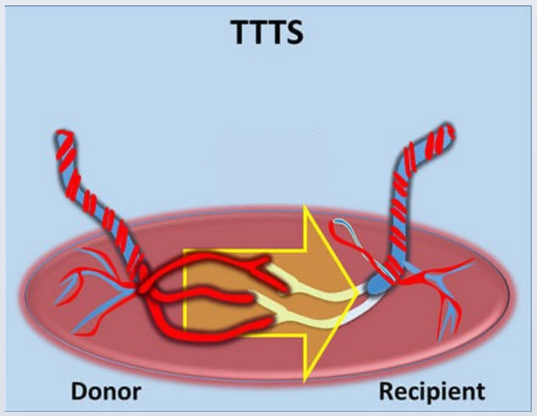
Background

- **Twin-to-Twin Transfusion Syndrome (TTTS)** is a condition that occurs in identical twins that share a placenta.
- TTTS occurs when blood vessels in the placenta connect the two fetuses, allowing one twin to receive too much blood and the other twin to receive too little.
- Without intervention, both twins die, and often the mother as well.



Source: Johns Hopkins Medicine

Figure 1. In TTTS, fluid flows along the connected blood vessels (in red) from the **donor** to the **recipient** as indicated by the yellow arrow.

- One treatment that shows promise is **laser surgery**, where surgeons cut connected blood vessels using laser.
- The success of the surgery depends on how many blood vessels the surgeon cuts.
- Imaging the placenta in advance gives the surgeon a **map to the blood vessels.**
- MRI is **too slow** to make this map—-a scan of a fetus may take **up to 10 minutes.**
- One way to accelerate MRI goes unused because it can be unreliable. **We found out why.**

Parallel Imaging

- **Parallel Imaging** takes advantage of multiple coils in the MRI machine.
- Each coil images the same part of the body, and these images are then **combined.**
- Combining these images can make scan time shorter by leaving out some data.
- Sometimes this combination creates bad images (Fig. 4).

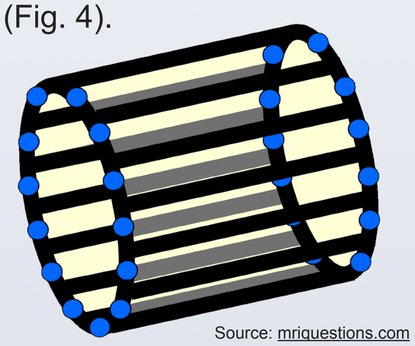


Figure 2. Cartoon of a typical MRI birdcage-style coil. This style of coil is very common. Each rung of the coil receives the image. The blue dots are capacitors.

Source: mriquestions.com

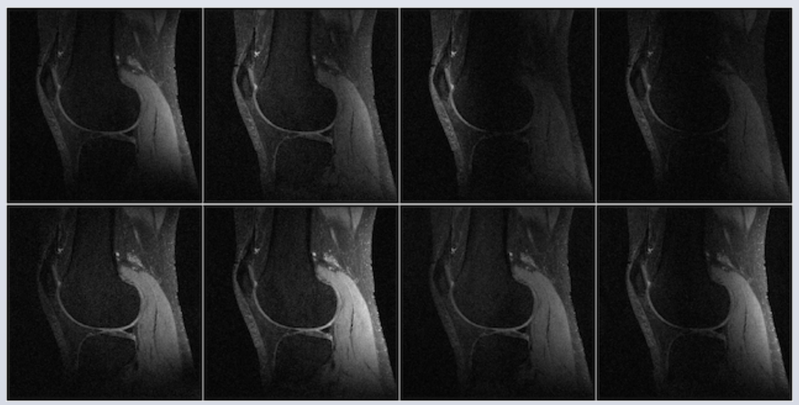


Figure 3. An example image produced by a coil like Figure 2. Notice how each image has a different “brightness” pattern.

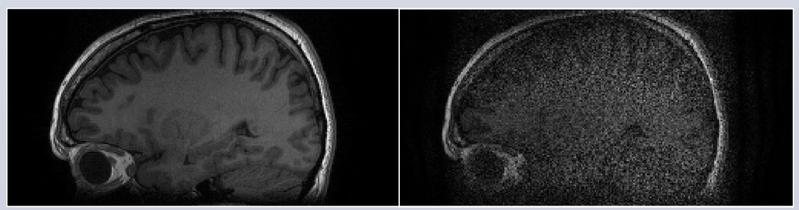


Figure 4. An example of a good image (left) and a bad image (right).

Parallel Imaging, cont.

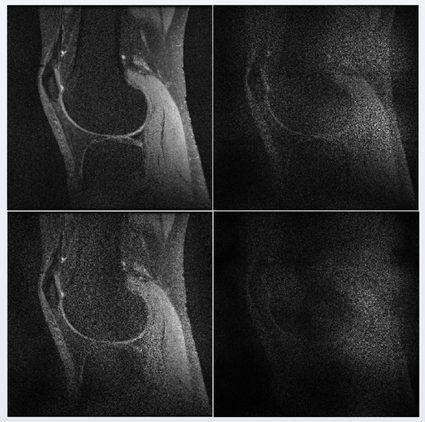


Figure 5. More examples of good (left) and bad (right) reconstructions. Each row uses the same amount of data.

- Since the reconstruction can be bad quality, this technique is **not used in the clinic**.

Our Work

- We have discovered why this technique can fail.
- With this knowledge, the image quality is **always good.**
- Using this technique in the clinic can reduce scan time by **up to a factor of 10**

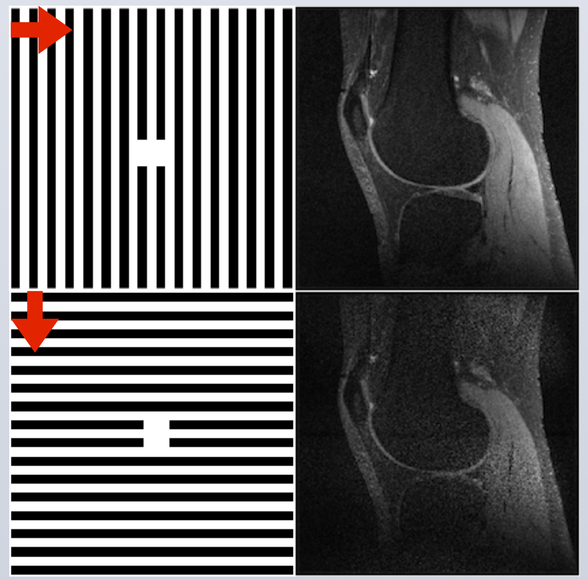


Figure 6. The difference between a good (top) and a poor (bottom) reconstruction is the direction of undersampling, shown by the red arrow.