(MD). An indirect visualization of the white fiber organization is possible using tractography algorithms [2]. The lack of available phantom reproducing the three dimension orientation, anatomical structure, and different diffusion properties, make that the validation is not optimal.

In this study, we developed a homemade phantom to imitate white matter tracts organization to improve the accuracy of diffusion measure.

Subjects and Methods:

The 3D skeleton as 6 slices reproducing isotropic and anisotropic anatomy properties. Slice1 is composed of 3 compartments of sucrose solutions with various concentrations; one of hydro-alcoholic gel and another of pure water. The Slice 2 is composed of 5 longitudinal bundles. Different U-shape bundles were placed in slice 3. The slice 4 imitates different angular bundles. The slice 5 makes 2 crossing bundles and 1 S-shape. Finally, slice 6 permits the position of fan shape with a specific device. Dyneema and nylon fibers were used. This test object was validated with a 3T MR scanner using the same parameters used for clinical practice.

Post-processing consisted to investigate the number, value and the combination of b-value points needed to accurate ADC measurement.The diffusion tensor data was calculated for each voxel. Then tracts were reconstructed using deterministic algorithms (Interpolated Streamline, FACT, tensorline) to evaluate position error and tractography shifts.

Results:

Analysis revealed under-estimation about -7% in the mean of ADC between the clinical acquisition protocols (as b1=0 s/mm^2) and reference (11 b-values). In comparison with b1>0 s/mm^2, the relative difference was less than 1.5%. In fiber bundles, FA, MD, did not significantly differ with fiber shape ($p>0.05$) and imaging session. Tractography algorithms used were all able to reconstruct all fiber bundles.

Discussion/Conclusion:

We suggest using b1=50 to guaranty accuracy of ADC. FA, MD, values were similar across imaging sessions and the different fiber shapes were representative of the human white fibers anatomy. Tractography was doable on the phantom and length of detected fibers varied depending of the used material and algorithm.

This new phantom significantly expands the potential of quality control in diffusion imaging to improve the accuracy of diffusion data and tractography in clinical practice.

References:

[1] Basser et al., 1994
[2] Fillard et al. 2011

627

Orthodontic appliances and quality of cleft and speech MRI.

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Purpose/Introduction: MRI is a promising tool for the assessment of cleft palate anatomy and the evaluation of velopharyngeal function during speech [1,2]. Stainless steel and other metals used in prosthetic dentures and orthodontic braces are known to create artefacts around facial area [3]. In general implants do not present safety concern at field less than 3T [4] and are of little concern for image quality in brain imaging [3]. However, due to their proximity, they are likely to interfere with palate imaging. The purpose of this work is to investigate in more detail the effects that different appliances commonly used in braces may have on MR image quality.

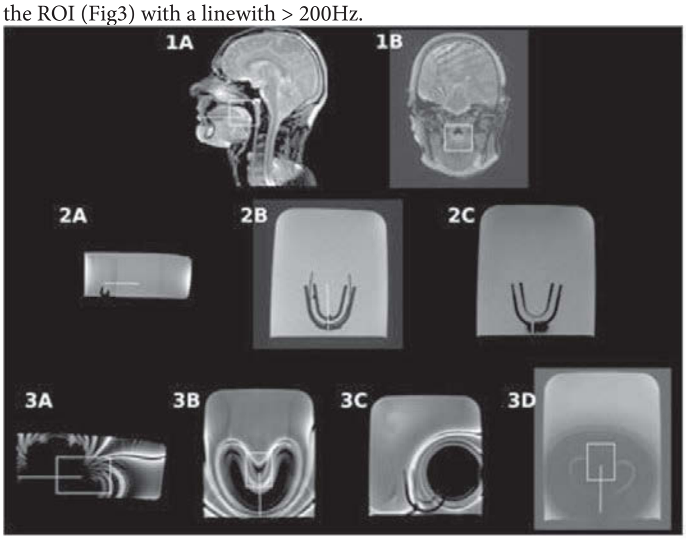
Subjects and Methods: Measurements were performed on 1.5T Philips Achieva (Best, the Nertherlands).

Examined appliances included archwires and push-coils (both titanium alloy and stainless steel), stainless steel molar bands and brackets (3D, USA).

These were mounted on a plastic mouth guard immersed in a copper(II) sulfate solution.

MRI sequences included: spin echo (TE=10 ms; TR=800ms), bSFFP (TE=1.6 ms, TR=2.9 ms used for real time acquisition [1]) and 3D T2 weighted sequences for anatomical imaging. From in vivo images an average ROI was defined as the region that encloses the soft palate (rectangular volume as shown in Fig 1); image quality was assessed within ROI (artefact size and a linewidth).

Results: The most prominent effect was local signal loss around metallic parts. Titanium elements (arch wire with push-coil) had minimal effect (Fig 2); and linewith from ROI water signal was < 20 Hz. The area affected by individual molar bands and stainless steel archwires was large and signal loss reached the ROI (Fig3) with a linewith > 200Hz.



Discussion/Conclusion: Metallic orthodontic appliances have different effects on image quality. They are of little concern when made from titanium alloys. However, stainless steel arch wires and stainless steel molar bands create extensive distortion which can produce artefacts in the palate region. The extent of artefacts caused by metallic brackets when mounted on the front teeth is limited and does not extend to the ROI, but may become problematic when placed on the back teeth. Type of patient's orthodontic devices should be included in the screening process, and it might be necessary to remove them before imaging.

References:

1. Bae et al *Cleft Palate Craniofac J* 2011;48:695-707.
2. Scott et al *Brit J Radiol* 2012;85:e1083-92.
3. Sadowsky et al *Angle Orthodont* 1988;Jan:9-19.
4. Shellock *Reference Manual MRI Safety, Implants and Devices* 2011.