

Image Acquisition & Reconstruction

- May 3, 2016 AGENDA
 - Update on latest profile (May 1, 2016 version)
 - ‘clean-up’ of version from last big SPECT meeting
 - Reconstruction Section of Profile
 - First draft of Specifications Table (section 3.7.2)
 - Need feed back **JUST GOT UPDATES FROM ERIC**
 - Groundworks project related to Acquisition & Recon
 - Discuss any modifications of budget/scope
 - Assessment (Section 4) – assign [DISCUSS at BIG MEETING]
 - Future meetings – fewer meetings, but longer? [DISCUSS AT BIG MEETING]

Section 3.7

3.7. Image Data Reconstruction

This activity describes criteria and procedures related to producing images from the acquired data that are necessary to reliably meet the Profile Claim.

3.7.1 DISCUSSION (REPLACE WITH ERIC'C UPDATES)

Reconstruction is performed on the projection data following a quality control check of the sinogram to assess for any motion **and potential artifacts** . Goal of the reconstruction is to provide a well-delineated basal ganglia which allows regional sampling of the caudate and putamen. Alterations in dopamine transporter density are asymmetric with regard to the caudate and putamen as well as the left and the right side of the brain. The reconstructions may be typically performed with an iterative (OSEM) or filtered back projection algorithm, corrected for attenuation using a theoretical correction (Chang 0) or a measured correction employing CT. If filtration is applied to the images it is important that the filter be linear across the count ranges.

Section 3.7.2 [Specification]

(first part below is from FDG PET profile)

Parameter	Actor	Requirement
SPECT Image Reconstruction	Study Sponsor(?)	<p>The key SPECT reconstruction parameters (algorithm, iterations, smoothing, field of view, voxel size) shall be specified in a manner that is expected to produce comparable results regardless of the scanner make and model.</p> <p>The key SPECT image reconstruction parameters shall be specified according to pre-determined harmonization parameters.</p>
	Technologist	<p>The key SPECT reconstruction parameters (algorithm, iterations, smoothing, field of view, voxel size) shall be followed and set as specified in order to produce comparable results regardless of the scanner make and model.</p>

Section 3.7.2 [Specification]

WILL INCORPORATE ERIC'S VERSION)

Parameter	Actor	Requirement
Reconstruction Method	Technologist	<p>Iterative reconstruction with sufficient number of updates shall be used. For OS-EM it has been shown that the use of 100 updates (subsets times iterations) is reasonable for measuring SBR [Dickson et al, EJNMMI 2010].</p> <p>TAKE OUT of BOX SINCE FBP OK</p>
SPECT Matrix/Voxel size	Technologist	<p>The Technologist shall perform the image reconstruction such that the matrix, slice thickness, and reconstruction zoom shall yield a voxel size of < 4 mm (same as projection bin size) in all three dimensions, although not necessarily isotropic.</p> <p>The final size shall not be achieved by re-binning, etc., of the reconstructed images.</p>

Section 3.7.2 [Specification]

Parameter	Actor	Requirement
Correction: Attenuation	Technologist	<p>Uniform or non-uniform attenuation correction shall be included in the reconstruction.</p> <p>For uniform correction a narrow beam attenuation coefficient of 0.148 cm⁻¹ shall be used when scatter correction is included while a broad beam attenuation coefficient of 0.11 cm⁻¹ shall be used when scatter correction is not included. (what about with fanbeam collim). (say something about contours)</p> <p>For non-uniform attenuation correction the CT-derived attenuation map shall be used.</p>
Correction: Scatter	Technologist	<p>It is strongly recommended (take out of box) that triple-energy window scatter correction be included in the reconstruction. (say something about checking window weighting factors and smoothing of narrow windows)</p>

Section 3.7.2 [Specification]

Parameter	Actor	Requirement
Resolution Recovery	Technologist	Reconstruction can be performed with or without incorporating resolution recovery (depth dependent or independent point-spread function modeling). Will need to check for artifacts if resolution recovery is incorporated.
Post-filtering	Technologist	For data reconstructed without resolution recovery, 3-dimensional post-filtering shall be used. A low pass (e.g. Butterworth) filter is recommended.

Should we mention PVC here ?

Submitted SPECT ground works project

PIs: Dewaraja & Dickson

- **Title:** Multi-center phantom study to characterize bias and precision of quantitative ^{123}I SPECT
- **Objective:** To determine the acquisition parameters and reconstruction methods for measuring SBR in ^{123}I ioflupane SPECT with higher precision and reduced bias.
 - **Goal is to improve differentiation between disease and non-disease groups, and improve sensitivity for assessing changes in longitudinal studies**
- **Deliverables:** The optimal acquisition parameters and reconstruction methods identified will be incorporated in to the QIBA profile (missing data for strong recommendation). The proposed studies will also provide input on finalizing the claim in the profile. All raw data and images will be available to the QIBA community for future projects including evaluation of image analysis software.

Phantom study to characterize bias and precision of quantitative ^{123}I SPECT

- Using the physical (striatal) phantom and commercial software we will
 - Evaluate the impact of modeling scatter+penetration, attenuation and including resolution recovery on accuracy and precision of the SBR. (Specify lowest CT dose)Effect of reducing CT dose for attenuation maps.
 - Evaluate the impact of total counts on accuracy and precision of the SBR.
 - Evaluate performance with low-energy (LE) vs. medium energy (ME) collimators.

Potential modifications

(may need to modify budget/scope)

- Two centers with Siemens & GE systems were included
 - Depending on budget can adjust to one center ~~or to three~~ to include ~~Phillips system~~
- Some adjustments still possible
 - What is most important to evaluate? Few studies available
 - resolution recovery?
 - Do both centers need to do all of the studies? (**No**)
 - Impact of total counts, ME vs. LE, effect of reducing CT dose (reducing mAs) for attenuation maps
 - Other
 - Evaluate absolute quantification?
 - ~~Evaluate image analysis software (future project?)~~