DICOM Correction Proposal

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<tr>
<td>Date of Last Update</td>
<td>2023/12/28</td>
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<tr>
<td>Person Assigned</td>
<td>Kevin O'Donnell</td>
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<td>Submitter Name</td>
<td>Kevin O'Donnell</td>
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<td>Submission Date</td>
<td>2023/10/26</td>
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Correction Number: CP-2370

Log Summary: Orientation guidance for vertical CT gantries

Name of Standard: PS 3.3, PS 3.17

Rationale for Correction:
The most CT gantries have a bore with a horizontal axis and a patient table that moves horizontally in and out of the bore from one side. The usage of attributes relating to patient orientation and couch movement are well understood in this configuration.

Gantries exist where the bore is vertical, the patient stands or is seated in the middle of the bore, and the gantry moves up and down to scan the patient. This CP provides guidance on the usage of related attributes in this configuration.

The gantry may scan top to bottom or bottom to top. It would be very unusual for the patient to be inverted. It is desirable that images from vertical gantries not be mislabeled when presented by naive viewers that have not been specifically coded to consider such gantries.

Q. If we do not introduce new codes, would it be a useful convention to provide some cue to the radiologist that the scan is unusual by adopting the convention of using the more unusual of the existing codes (e.g. supine) when the selection is arbitrary?

Q. Since the patient could readily face any direction while standing, does the modality need a convention to set cosines correctly?

Correction Wording:

Add the following section to WG6Q

Guidance for Vertical Gantry

This section provides guidance on the population of position and orientation attributes in images that were acquired on a vertical gantry. A vertical gantry is defined as one where the bore is aligned in the direction of gravity (See Figure X), while a conventional gantry has the bore aligned horizontally (i.e. orthogonal to gravity). This text assumes that if motion is required to cover the scan range, the gantry moves up and/or down during scanning, however the guidance would also apply if the patient support were to move up and/or down instead.

Position and orientation can be considered in terms of the pixels with respect to the patient, the patient with respect to the gantry, and the patient with respect to gravity.
The position and orientation of the pixels with respect to the patient is independent of the gantry and is thus the same for both vertical and conventional gantries. The Image Plane Module includes two Type 1 attributes for Image Position (Patient) (0020,0032) and Image Orientation (Patient) (0020,0037) which provide a mathematical description. As stated in PS3.C.7.6.2.1.1 these are defined in the patient-based coordinate system which is a right-handed system where:

- x-axis is increasing to the left-hand side of the patient
- y-axis is increasing to the posterior side of the patient
- z-axis is increasing toward the head of the patient.

Image Position (Patient) (0020,0037) contains the x, y, and z coordinates of the Top Left-Hand Corner (TLHC) of the image. Image Orientation (Patient) (0020,0032) contains direction cosines of image first row and first column.

The Image Module includes the Type 2C attribute Patient Orientation (0020,0020) which provides a rough orientation. As stated in PS3.C.7.6.1.1.1 two letters indicate the direction from the first to last pixel in a row, and the direction from the first to last pixel in a column, respectively using letters for Anterior, Posterior, Left, Right, Head, and Feet.

Q. Is there any value to including guidance to displays about using this for hanging protocols?

The position and orientation of the patient with respect to the gantry is generally expressed in terms of the "front" of the gantry. To maintain as much consistency as possible, for a vertical gantry, the front of the imaging equipment is considered to be the side containing the bore that is closest to the ground.

Q. Conventional Patient position is often expressed in a way that combines the scan axis (as the scan progresses from one frame to the next, what direction is it moving, e.g. from the head incrementally toward the feet) and a "rotation" around that axis (how the patient is rotated around that axis expressed with respect to gravity/table, e.g. prone, supine, decubitus left, etc.). This is nicely factored into 3 attributes in the Patient Orientation Module, but that is currently only available in Mammo and 3D angio. Can we make it available in CT? Elsewhere?

Series Module

Patient Position (0018,5100) Type 2C
- [relative to equipment, for annotation only]

Fallback for Patient Orientation Code Seq.

Q. Defined terms so we could add values for erect? Or we could leave blank? Or we could specify that for a vertical gantry, the "front" is the horizontal gantry face facing the ground?

When facing the front of the imaging equipment,

- Head First is defined as the patient's head being positioned toward the front of the imaging equipment (i.e., head entering the front of the equipment).
- Feet First is defined as the patient's feet being positioned toward the front of the imaging equipment (i.e., feet entering the front of the equipment).
- Left First is defined as the patient's left side being positioned towards the front of the imaging equipment (i.e., patient's left side entering the front of the equipment).
- Right First is defined as the patient's right being positioned towards the front of the imaging equipment (i.e., patient's right side entering the front of the equipment).

Commented [OK2]: The last two sentences of the first paragraph do not read quite right.
https://dicom.nema.org/medical/dicom/current/output/shtml/part03/sect_C.7.6.2.html#sect_C.7.6.2.1.1

Commented [OK3]: https://dicom.nema.org/medical/dicom/current/output/shtml/part03/sect_C.7.6.2.html#sect_C.7.6.2.1.1
• **Prone** is defined as the patient's face being positioned in a downward (gravity) direction.

• **Supine** is defined as the patient's face being in an upward direction.

• **Decubitus Right** is defined as the patient's right side being in a downward direction.

• **Decubitus Left** is defined as the patient's left side being in a downward direction.

Anatomical Orientation Type (0010,2210)  

[BIPED vs QUADRUPED] If this Attribute is not present, the default human standard anatomical position is used to define the patient orientation of projection images and the Patient-Based Coordinate System of cross-sectional images.

Table Position (0018,9327) – Enhanced CT - "Positions as the table moves into the gantry viewed from the front are more negative."; reference point is implementation specific

**Patient Orientation Module** – only 3D angio and Mammo?

Patient Orientation Code Sequence (0054,0410) – [with respect to gravity] – erect, recumbent, semi-erect

Patient Orientation Modifier CS (0054,0412) - --20 codes, standing, supine, prone, sitting, etc

Patient Gantry Relationship CS (0054,0414) - --8 codes, headfirst, feetfirst, leftfirst, etc.


While not specifically about orientation, it may often be appropriate for acquisitions on a vertical gantry to include the Acquisition Context Sequence (0040,0555) with an item for (130324, DCM, "Functional condition present during acquisition") = (87731000, SCT, "Weight bearing"). See also TID 3460.