

DICOM Correction Item

Correction Number	CP-533
Log Summary: Derivation history of pixel data	
Type of Modification	Name of Standard
Correction	PS 3.3, 3.16 2004
<p>Rationale for Correction</p> <p>In general, two aspects of maintaining "history" information within the image objects themselves are relatively weak; one is the history of the pixel data; the other is the history of the entire object, such as when other non-pixel data attributes are modified, removed, added or coerced. This CP does not propose to address this fundamental limitation. However, there are some aspects of derivation history and referencing prior images that need clarification.</p> <p>The number of items allowable for Derivation Code Sequence (0008,2112) is not specified.</p> <p>Though this attribute is a coded form of Derivation Description (0008,2111), which has a VM of 1, it is probably appropriate to allow more than one item for Derivation Code Sequence (0008,2112) since a) it was not otherwise constrained when added to the standard and may have legitimately implemented with more than one item, and b) there are use cases for describing the successive application of multiple derivation steps.</p> <p>For comparison, both Lossy Image Compression Ratio (0028,2112) and Lossy Image Compression Method (0028,2114) are explicitly are multivalued to be able to convey a history of successive lossy compressions.</p> <p>If multiple items are present in Derivation Code Sequence (0008,2112), then their meaning in relation to one another needs to be described, either to imply successive application of derivation steps, to emphasize that it is not defined. The former is proposed.</p> <p>Currently there is no specified succession semantics for multiple items in the Source Image Sequence (0008,2112), and the presence of multiple items might mean those images were combined to make the derived image (e.g. multiple source images to make an MPR or MIP), or each of the items represents a step in the successive derivation of an image (e.g. when an image has had successive lossy compression steps applied to it), or some combination.</p> <p>The Purpose of Reference Code Sequence (0040,A170), could be used to distinguish such cases, but there is still no way of indicating the order of succession and distinguishing when multiple images are combined to create this image as opposed to multiple images being derived from one another in a particular order.</p> <p>It is proposed to add a specific code to indicate "Lossy compressed predecessor" in addition to the existing (DCM,121320, "Uncompressed predecessor"), and a note to indicate that the sequence of derivation can be determined, if necessary, by examining the attributes within the reference images themselves.</p>	
Sections of documents affected	
PS 3.3 C.7.6.1	
PS 3.16 CID 7202 and Annex D	
Correction Wording:	

Amend PS 3.3 C.7.6.1:

**Table C.7-9
GENERAL IMAGE MODULE ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
...
Derivation Description	(0008,2111)	3	A text description of how this image was derived. See C.7.6.1.1.3 for further explanation.
Derivation Code Sequence	(0008,9215)	3	A coded description of how this image was derived. See C.7.6.1.1.3 for further explanation. <u>One or more Items may be included in this Sequence. More than one Item indicates that successive derivation steps have been applied.</u>
<i>>Include 'Code Sequence Macro' Table 8.8-1</i>			<i>Defined Context ID is 7203.</i>
Source Image Sequence	(0008,2112)	3	A Sequence that identifies the set of Image SOP Class/Instance pairs of the Images that were used to derive this Image. Zero or more Items may be included in this Sequence. See C.7.6.1.1.4 for further explanation.
>Referenced SOP Class UID	(0008,1150)	1C	Uniquely identifies the referenced SOP Class. Required if Source Image Sequence (0008,2112) is sent.
>Referenced SOP Instance UID	(0008,1155)	1C	Uniquely identifies the referenced SOP Instance. Required if Source Image Sequence (0008,2112) is sent.
>Referenced Frame Number	(0008,1160)	3	References one or more image frames of a Multi-frame Image SOP Instance, identifying which frames were used to derive this image, and the reference is not to all frames. Note: If this Attribute is not present, all frames of the SOP Instance are referenced.
>Purpose of Reference Code Sequence	(0040,A170)	3	Describes the purpose for which the reference is made, that is what role the source image or frame(s) played in the derivation of this image. Only a single Item shall be permitted in this sequence.
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>			<i>Defined Context ID is 7202.</i>
...
Lossy Image Compression	(0028,2110)	3	Specifies whether an Image has undergone lossy compression. Enumerated Values: 00 = Image has NOT been subjected to lossy compression.

			01 = Image has been subjected to lossy compression. See C.7.6.1.1.5
Lossy Image Compression Ratio	(0028,2112)	3	Describes the approximate lossy compression ratio(s) that have been applied to this image. See C.7.6.1.1.5 for further explanation. May be multivalued if successive lossy compression steps have been applied. Notes: 1. For example, a compression ratio of 30:1 would be described in this Attribute with a single value of 30. 2. For historical reasons, the lossy compression ratio may also be described in Derivation Description (0008,2111).
Lossy Image Compression Method	(0028,2114)	3	A label for the lossy compression method(s) that have been applied to this image. See C.7.6.1.1.5 for further explanation. May be multivalued if successive lossy compression steps have been applied; the value order shall correspond to the values of Lossy Image Compression Ratio (0028,2112). Note: For historical reasons, the lossy compression method may also be described in Derivation Description (0008,2111).
...

C.7.6.1.1 General Image Attribute Descriptions

...

C.7.6.1.1.3 Derivation Description

If an Image is identified to be a derived image (see C.7.6.1.1.2 Image Type), Derivation Description (0008,2111) and Derivation Code Sequence (0008,9215) describe the way in which the image was derived. They may be used whether or not the Source Image Sequence (0008,2112) is provided. They may also be used in cases when the Derived Image pixel data is not significantly changed from one of the source images and the SOP Instance UID of the Derived Image is the same as the one used for the source image.

- Notes: 1. Examples of Derived Images that would normally be expected to affect professional interpretation and would thus have a new UID include:
- a. images resulting from image processing of another image (e.g. unsharp masking),
 - b. a multiplanar reformatted CT image,
 - c. a DSA image derived by subtracting pixel values of one image from another.

- d. an image that has been decompressed after having been compressed with a lossy compression algorithm. To ensure that the user has the necessary information about the lossy compression, the approximate compression ratio may be included in Derivation Description (0008,2111).

An example of a Derived Image that would normally not be expected to affect professional interpretation and thus would not require a new UID is an image that has been padded with additional rows and columns for more display purposes.

2. An image may be lossy compressed, e.g., for long term archive purposes, and its SOP Instance UID changed. PS3.4 provides a mechanism by which a query for the original image Instance may return a reference to the UID of the lossy compressed version of the image using the Alternate Representation Sequence (0008,3001). This allows an application processing a SOP Instance that references the original image UID, e.g., a Structured Report, to obtain a reference to an accessible version of the image even if the original SOP Instance is no longer available.

C.7.6.1.1.4 Source image sequence

If an Image is identified to be a Derived image (see C.7.6.1.1.2 Image Type), Source Image Sequence (0008,2112) is an optional list of Referenced SOP Class UID (0008,1150)/ Referenced SOP Instance UID (0008,1150) pairs that identify the source images used to create the Derived image. It may be used whether or not there is a description of the way the image was derived in Derivation Description (0008,2111) or Derivation Code Sequence (0008,9215).

Note: Multiple Items may be present within Source Image Sequence (0008,2112), in which case either:

- a) **those images were combined to make the derived image (e.g. multiple source images to make an MPR or MIP), or**
- b) **each of the items represents a step in the successive derivation of an image (e.g. when an image has had successive lossy compression steps applied to it),**
- c) **some combination of the above.**

The Purpose of Reference Code Sequence (0040,A170) and the Attributes within the referenced images themselves may be used to determine the history of the derivation, which is not otherwise explicitly specified.

C.7.6.1.1.5 Lossy Image Compression

The Attribute Lossy Image Compression (0028,2110) conveys that the Image has undergone lossy compression. It provides a means to record that the Image has been compressed (at a point in its lifetime) with a lossy algorithm and changes have been introduced into the pixel data. Once the value has been set to "01", it shall not be reset.

Note: If an image is compressed with a lossy algorithm, the attribute Lossy Image Compression (0028,2110) is set to "01". Subsequently, if the image is decompressed and transferred in uncompressed format, this attribute value remains "01".

The value of the Lossy Image Compression (0028,2110) Attribute in SOP Instances containing multiple frames in which one or more of the frames have undergone lossy compression shall be "01".

Note: It is recommended that the applicable frames be noted in the Attribute Derivation Description (0008,2111).

If an image is originally obtained as a lossy compressed image from the sensor, then Lossy Image Compression (0028,2110) is set to "01" and Value 1 of the Attribute Image Type (0008,0008) shall be set to ORIGINAL.

If an image is a compressed version of another image, Lossy Image Compression (0028,2110) is set to "01", Value 1 of the Attribute Image Type (0008,0008) shall be set to DERIVED, and if the predecessor was a DICOM image, then the Image shall receive a new SOP Instance UID.

Note: 1. It is recommended that the approximate compression ratio be provided in the Attribute Derivation Description (0008,2111). Furthermore, it is recommended that Derivation Description (0008,2111) be used to indicate when pixel data changes might affect professional interpretation. (see C.7.6.1.1.3).

2. The attribute Lossy Image Compression (0028,2110) is defined as Type 3 for backward compatibility with existing IODs. It is expected to be required (i.e., defined as Type 1C) for new Image IODs and for existing IODs that undergo a major revision (e.g. a new IOD is specified).

The Defined Terms for Lossy Image Compression Method (0028,2114) are:

ISO_10918_1 = JPEG Lossy Compression

ISO_14495_1 = JPEG-LS Near-lossless Compression

ISO_15444_1 = JPEG 2000 Irreversible Compression

ISO_13818_2 = MPEG2 Compression

Amend PS 3.3 C.7.6.16.2.6

C.7.6.16.2.6 Derivation Image Macro

Table C.7.6.16-7 specifies the attributes of the Derivation Image Functional Group macro.

**Table C.7.6.16-7
 DERIVATION IMAGE MACRO ATTRIBUTES**

Attribute Name	Tag	Type	Attribute Description
Derivation Image Sequence	(0008,9124)	2	A sequence that provides reference to the set of SOP Class/Instance pairs of the Images or other composite SOP Instances which were used to derive this frame. Zero or more Items may be included in this Sequence.
>Derivation Description	(0008,2111)	3	A text description of how this frame data was derived. See C.7.6.1.1.3 for further explanation.
>Derivation Code Sequence	(0008,9215)	1	A coded description of how this frame was derived. See C.7.6.1.1.3 for further explanation. <u>Zero or more Items may be included in this Sequence. More than one Item indicates that successive derivation steps have been applied.</u>
<i>>>Include 'Code Sequence Macro' Table 8.8-1</i>			<i>Defined Context ID is 7203.</i>
>Source Image Sequence	(0008,2112)	2	A Sequence which identifies the set of Image or other SOP Class/Instance pairs of the Instances which were used to derive this frame. Zero or more Items may be included in this Sequence. See C.7.6.1.1.4 for further explanation.
<i>>>Include 'Image SOP Instance Reference Macro' Table 10-3</i>			
>>Purpose of Reference Code Sequence	(0040,A170)	1	Describes the purpose for which the reference is made, that is what role the source image or frame played in the derivation of this image or frame. Only a single Item shall be permitted in this sequence.
<i>>>>Include 'Code Sequence Macro' Table 8.8-1</i>			<i>Defined Context ID is 7202.</i>

Add code to PS 3.16 CID 7202:

CID 7202 Source Image Purposes of Reference

**Context ID 7202
 Source Image Purposes of Reference
 Type: Extensible Version: 20051101**

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	121320	Uncompressed predecessor
DCM	121321	Mask image for image processing operation
DCM	121322	Source image for image processing operation
DCM	121329	Source image for montage
DCM	121330	Lossy compressed predecessor

Add definition to PS 3.16 Annex D:

121320	Uncompressed predecessor	<u>An image that has not already been lossy compressed that is used as the source for creation of a lossy compressed image</u>	
121321	Mask image for image processing operation	<u>Image used as the mask for an image processing operation, such as subtraction</u>	
121322	Source image for image processing operation	<u>Image used as the source for an image processing operation</u>	
121324	Source Image	Image used as the source for a derived or compressed image	
121325	Lossy compressed image	Image encoded with a lossy compression transfer syntax	
121326	Alternate SOP Class instance	SOP Instance encoded with a different SOP Class but otherwise equivalent data	
121327	Full fidelity image	Full fidelity image, uncompressed or lossless compressed	
121328	Alternate Photometric Interpretation image	Image encoded with a different photometric interpretation	
121329	Source image for montage	Image used as a source for a montage (stitched) image	

<u>121330</u>	<u>Lossy compressed predecessor</u>	<u>An image that has previously been lossy compressed that is used as the source for creation of another lossy compressed image</u>	
121401	Derivation	Method of deriving or calculating a measured value (e.g., mean, or maximum of set)	