March 28, 2013

Dicom Image Release Notes

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Information about the protocols and study design for Osteoarthritis Initiative (OAI) can be found on the OAI Online website:

http://www.oai.ucsf.edu/

The subcohort definitions, manuals describing all image acquisition procedures and parameters, as well as all clinical data can be found on OAI Online. Specific files of interest include: (a) “Overview of Structure, Use, and Conventions for OAI data” contains details of the SAS clinical and imaging meta-data files; (2) “OAI Data Release Version Conventions” contains descriptions of the clinical and imaging data version conventions.

1. PARTICIPANTS FOR WHOM IMAGES ARE AVAILABLE

1.1 Participant Subcohorts and Demographics

Images are available for all 4796 OAI Study participants, of whom 1390 participants are in the Progression subcohort, 3284 participants are in the Incidence subcohort and 122 participants are Non-exposed Controls. The following tables describe the ENROLLMENT age, sex and race distributions for the entire OAI Study cohort.

Distribution by Race and Sex

Gender	White or Caucasian	Non-White	Unknown	Total Races
Male	1666	323	3	1992
Female	2124	678	2	2804
Total male and female	3790	1001	5	4796

Distribution by Age and Sex

Gender	Age 45 to 49 years	Age 50 to 59 years	Age 60 to 69 years	Age 70 to 79 years	Total of all ages
Male	259	739	495	499	1992
Female	290	923	968	623	2804
Total male and female	549	1662	1463	1122	4796

1.2 Participant Clinical, Measurement and Biomarker Data

Questionnaire and clinical measurement data are available as SAS datasets as well as comma separated values (CSV) format on the OAI Online website. To obtain the most up-to-date clinical data on these participants, the latest version of the clinical datasets will need to be retrieved. The ENROLLEES SAS dataset contains variables to determine whether a participant has knee MRI and/or knee X-Rays available at specific visits.

For a specific visit, the sum of two variables (or value of one variable) is used to classify image availability.

VISIT	**Variables to use to check for Knee MRI and X-Rays**	**No Knee Images**	**Knee MRI**	**Knee X-Rays**	**Knee MRI & Knee X-Rays**
Baseline	V00IMAGESC[(a)]+V00IMAGESE	0	1	2	3

VISIT	Variables to use to check for Knee MRI and X-Rays	No Knee Images	Knee MRI	Knee X-Rays	Knee MRI & Knee X-Rays
12-month	V01IMAGESC[(a)]+V01IMAGESE	0	1	2	3
18-month	V02IMAGESD	0	1	n/a[(b)]	n/a[(b)]
24-month	V03IMAGESC[(a)] +V03IMAGESE	0	1	2	3
30-month	V04IMAGESG	0	1	n/a[(b)]	n/a[(b)]
36-month	V05IMAGESC +V05IMAGESE	0	1	2	3
48-month	V06IMAGESC + V06IMAGESE	0	1	2	3
72-month	V08IMAGESC + V08IMAGESE	0	1	2	3

Explanation for notes in the table:

(a) Non-zero value for variables V00/V01/V03IMAGESC means that images for a participant were released in an early image release of the specific visit prior to the release of images for the whole cohort

(b) MR images were only are acquired in subsets of participants at 18-month and 30-month interim visits.

Variables associated with contacts prior to enrollment are identified by a prefix starting with P (*e.g.,* P01 variables are from the screening visit where the baseline fixed flexion knee radiographs are acquired). Variables associated with enrollment visit are prefixed V00, variables at 12-month follow-up are prefixed V01, variables at 18-month interim visit are prefixed V02, variables at 24-month follow-up are prefixed V03, variables at 30-month follow-up are prefixed V04, variables at 36-month follow-up are prefixed V05, variables at 48-month follow-up visit are prefixed V06, and variables at 72-month follow-up visit are prefixed V08.

The imaging meta-data file on OAI Online identifies the availability of specific MR image series as well as which types of radiographs are available in which knee(s) for participants at specific visits.

For each visit, meta-data describing the type, acquisition, and quality of the images in this data release can be found in a pair of SAS datasets, XRAYxx and MRIxx, where xx is 00 for baseline, 01 for the 12-month, 02 for the 18-month visit, 03 for the 24-month visit, 04 for the 30-month visit, 05 for the 36-month visit, 06 for the 48-month visit, and 08 for the 72-month visit. For example, the dataset XRAY00 contains the X-Ray meta-data from baseline and XRAY01 contains the x-ray meta-data from the 12-month follow-up visit. Please note the X-Ray and MRI datasets have multiple records per participant. For example, the dataset XRAY00 contains one record per baseline radiograph expected or released for each of the participants in this image release. The dataset MRI00 contains one record per knee per baseline standard OAI MRI series (DICOM series), excluding MR localizer images, for each of the participants (section 2 of this document outlines the types of X-Ray and MR images that can be available for each knee). Further information can be found in the zipped documentation that accompanies each SAS dataset.

The imaging meta-data datasets MRIxx and XRAYxx will contain flag variables (VxxXQCFLAG for x-ray VxxMQCFLAG for MRI) to indicate images that have been acquired with various image acquisition problems, and the variables VxxXQCCMNT for x-ray, and VxxMQCCMNT for MRI will be a short text description of the problem. The MR flag and comment variables (V08MQCFLAG and V08MQCCMNT respectively) are available at the 72-month visit. For visits prior to 72-month, these variables currently do not exist, but will be added in future data releases.

2. IMAGES AVAILABLE

The visit identifier (the first digit of the image release identifier) matches the visit designator number described for clinical data variables in the previous section (eg: 0 = baseline, 1 = 12-month visit, 2 = 18-month visit, 3 = 24-month visit, 4 = 30-month visit, 5 = 36-month visit, 6= 48-month visit, 8= 72-month visit, 10= 96-month visit).

Appendices A and B provide information about further subgroups of participants who were included in early image releases.

The image releases may have been updated with additional images, updated images, or deleted images. A list of updates are kept on the OAI Online website in the “Changes to previously released images” link at http://www.oai.ucsf.edu/datarelease/DataImaging.asp

2.1 Image Identifiers (Barcodes)

Every radiograph has a unique 12 digit barcode associated with it and the first 5 digits are always 01660. These barcodes are used to identify X-Rays in the meta-data datasets (variables V00XRBARCD, V01XRBARCD, V03XRBARCD, V05XRBARCD, V06XRBARCD, and V08XRBARCD for baseline, 12-month, 24-month, 36-month, 48-month, and 72-month images in the XRAY00, XRAY01, XRAY03, XRAY05, XRAY06, and XRAY08 SAS datasets, respectively).

Each MR image series also has a unique 12 digit barcode associated with it and the first 5 digits are always 01661. These barcodes are used to identify MRI series (DICOM series) in the MRI meta-data datasets (variables V00MRBARCD, V01MRBARCD, V02MRBARCD, V03MRBARCD, V04MRBARCD, V05MRBARCD, V06MRBARCD, and V08MRBARCD for baseline, 12-month, 18-month, 24-month images, 30-month, 36-month, 48-month, and 72-month images in the MRI00, MRI01, MRI02, MRI03, MRI04, MRI05, MRI06, and MRI08 SAS datasets, respectively).

Please note that there are long (12 digit) and short (8 digit) versions of the barcodes. The 8-digit versions are used for folder names on the hard drive, and can be converted to the 12-digit version by prefixing them with 0166. If you import barcode data into spreadsheet or database programs, we recommend that you ensure that any leading zeros in the data are not lost.

2.2 Radiographs (Participants Eligible for Imaging, Visit When Image Acquired)

Baseline Images:

- Bilateral PA fixed flexion knees (all participants, Screening visit)
- AP Pelvis (all participants, Enrollment visit)
- PA Hand (all participants, Enrollment visit; unilateral dominant hand in 3 of 5 clinical centers, bilateral hand acquired at 2 of 5 clinical centers)
- Lateral knee radiographs (both knees, non-exposed controls only, Enrollment visit)

Follow-up Images:

- Bilateral PA fixed flexion knees (all participants, annual follow-up visits)
- AP Pelvis (48-month visit, and also 12-month visit if not acquired at baseline)
- PA Hand (48-month visit, and also 12-month visit, if not acquired at baseline; unilateral dominant hand in 3 of 5 clinical centers, bilateral hand acquired at 2 of 5 clinical centers)
- Lateral knee radiographs (both knees, non-exposed controls only, annual follow-up visits)
- AP full limb (progression and incidence subcohort, at one of the annual follow-up visits)

2.2.1 Fixed Flexion Knee Radiography and the Synaflexer Frame

This device is designed to standardize positioning and allow a check of the geometry used during fixed flexion knee radiography. The phantom consists of two parallel rows of metal beads of known separations encased in a plexiglass frame of known dimensions. On the radiographs, these metal beads appear in two vertical lines.

In an optimally acquired OAI fixed flexion radiograph, these lines will be almost exactly parallel, and the spacing between the beads for the line on the left of the image will be slightly greater than for the line on the right side of the image. Within each line of metal beads, the beads will have almost exactly equal spacings. The row of beads with the largest spacing is offset 1 ¾” (44.5mm) posteriorly from the point on which the patella presses against the frame during the exposure, and is hence in approximately the same coronal plane as the center of the tibio-femoral joint. The other row of beads is offset ¼” posteriorly from the point at which the patella presses against the frame. The actual vertical spacing of the beads is 1” (25.4mm), so by measuring the inter-bead spacing on the row of beads on the left side of the image, the conversion from image pixels to true distance at the joint line can be performed.

2.2.2 Full-Limb X-Rays

Radiographs of the entire lower extremities are taken together in an upright weight-bearing position, and the images include complete visualization of the femoral head, the knee and talus of the foot. The objective of this examination is to measure knee alignment. Both extremities are usually on one image, but for participants with extreme malalignment, or for large participants, there may be more than one image per participant, and each limb may be on a separate image.

2.3 Knee MRI (All Participants, Enrollment visit and Annual follow-up visits)

The MRI sequences typically acquired for both left and right knees are:

- Localizer (3-Plane) (MP_LOCATOR)
- Coronal Intermediate Weighted Turbo Spin Echo (COR_IW_TSE)
- Sagittal 3D DESS with Water Excitation (SAG_3D_DESS)
- Sagittal Intermediate Weighted Turbo Spin Echo with Fat Suppression (SAG_IW_TSE_FS)

The right knee typically also has two additional image seriess acquired:

- Coronal T1-weighted 3D Flash with Water Excitation (COR_T1W_3D_FLASH_WE)
- Sagittal T2 Mapping with a small field of view (SAG_T2_MAP)

If the right knee is not being imaged, then these two additional image series may be acquired for the left knee.

Multi-planar reformat (MPR) were performed from the SAG_3D_DESS images into:

- Coronal Plane MPR (COR_MPR_SAG_3D_DESS)
- Axial Plane MPR (AXIAL_MPR_SAG_3D_DESS)

For participants with a parametric T2 map calculated using the Siemens syngo MapIt software, there will be a set of images labeled SAG_T2_CALC to match the SAG_T2_MAP images from which they were calculated. See Section 2.3.1 for details about participants for whom these parametric images are available.

The acquisition parameters of each image series are provided in Appendix X. The abbreviations in parentheses after each series above (e.g.: COR_IW_TSE) is used to describe the pulse sequences in the DICOM image headers, and can usually be used in viewing software to identify images for loading or viewing.

Examples of assessments that can be performed using the OAI MR examination are:

1. Coronal IW TSE (COR_IW_TSE) enables assessment of the medial collateral ligament (MCL), lateral collateral ligament (LCL), osteophytes and cysts (medial - lateral central femur and central tibia), sclerosis (central femur and tibia), and the meniscal body.
2. Sagittal 3D DESS with water excitation (SAG_3D_DESS) enables quantification of cartilage volume over the entire knee (patellofemoral and femorotibial joints). Another primary use of the 3D DESS acquisition is to identify osteophytes in both the original sagittal (superior-inferior patella, anterior-posterior femur and tibia) as well as in the coronal (medial / lateral femur and tibia) and axial (medial-lateral patella) MPR. Secondarily, it also potentially provides assessment of subarticular marrow edema and cysts both in the original sagittal plane as well as in the coronal (central femur and tibia) and axial (patella) MPR. This latter marrow assessment does not have proven sensitivity and specificity, but is presumed to be less sensitive than a fat-suppressed IW or T2W.
3. Sagittal IW TSE with fat suppression (SAG_IW_TSE_FS) enables identification of subarticular marrow edema and cysts as well as quantitation of the joint effusion. The large (20cm) imaging field of view (FOV) covers the suprapatellar bursae as well as dissecting popliteal cysts. Additional assessments enabled by this acquisition include cartilage quality (signal hetereogeneity / T2 lesion), marrow edema and cysts, anterior cruciate ligament (ACL), posterior cruciate ligament (PCL), as well as osteophytes (superior – inferior patella, anterior – posterior femur and tibia).
4. Coronal T1W 3D FLASH with water excitation (COR_T1W_3D_FLASH_WE) enables quantitation of cartilage volume over the central load-bearing compartment of the knee (femorotibial joint). Another primary use of the 3D FL acquisition is to identify medial / lateral osteophytes on the femur and tibia in

the original coronal plane. Secondarily, it also potentially provides assessment of subarticular marrow edema and cysts in the coronal plane (central femur and tibia). This latter marrow assessment does not have proven sensitivity and specificity, but is presumed to be less sensitive than a fat suppressed IW or T2W.

5. Sagittal T2 map (SAG_T2_MAP) is a 7 echo (every 10msec) acquisition using a 12cm imaging FOV. The resulting image contrasts include PD, IW, and T2W. These images enable assessment of subchondral bone (PD, T2W) for sclerosis, cysts and edema, the meniscal horns (PD), and for cartilage morphology and quality (PD, IW and T2W).

Calculated T2 Value Images are:

For 72-month and 96-month imaging visits, the OAI MRI system software was upgraded to include Siemens syngo MapIt package (https://healthcare.siemens.com/magnetic-resonance-imaging/options-and-upgrades/clinical-applications/syngo-mapit) which automatically calculates the T2 value parametric maps from the multi-echo SAG_T2_MAP images. For each site, there is a specific date on which this occurred:

- Site A: SAG_T2_MAP scans from 12/21/2011 will have a matching set of parametric T2 images
- Site B: SAG_T2_MAP scans from 6/3/2010 will have a matching set of parametric T2 images
- Site C: SAG_T2_MAP scans from 7/12/2010 will have a matching set of parametric T2 images
- Site D: SAG_T2_MAP scans from 5/19/2010 will have a matching set of parametric T2 images
- Site E: SAG_T2_MAP scans from 12/20/2011 will have a matching set of parametric T2 images

2.4 Thigh MRI

(All Participants, Baseline or 12-month visit, with follow-up at 24-month visit or 36-month visit, 48-month visit, and 96-month visit)

Thigh MRI exams were obtained on the majority of participants at baseline (enrollment visit), and if not obtained at that visit, an additional attempt was made to acquire one at the 12-month follow-up visit. Images were then also acquired at the 24-month annual visit, and if not obtained at that visit, an additional attempt was made to acquire one at the 36-month follow-up visit. Thigh MRI exams were also acquired at the 48-month and 96-month follow-up visits. The images available comprise axial T1-weighted images with 15 contiguous slices 3.0mm thick with the most distal slice being 10cm superior to the right medial femoral epiphysis. These images are labeled AX_T1_THIGH. There are also localizer series (labeled MP_LOCATOR_THIGH) and in the majority of participants, also an additional image (labeled PRESCRIPTION_THIGH) which shows the levels of the axial slices overlaid on the localizer images.

2.5 Rules for Release of Acquired Images

Rules for which images are released (for example, when more than one instance of a radiograph or MRI series are acquired at a given visit - baseline, 12-month follow-up visit, etc.) are described below:

2.5.1 Radiographs

a. Images with pending radiograph-related queries will not be included in a release.
b. Only one image (acquisition) of a radiograph of each type from a given visit will be released.
    i. Usually, this will be an "accepted" instance (i.e., either an image that is of acceptable quality based on central QA review or one that was not selected for central QA review and was accepted by default without QA review). In cases where there is more than one "accepted" instance of a type from a given visit, the central imaging QA center will identify the instance of the best overall quality for release.
    ii. Unacceptable quality (based on central QA review) images will not be released, except when there is no "accepted" instance available, in which case an unacceptable quality image of that type will be released. When no "accepted" instance is available and more than one unacceptable quality image exists, the central imaging QA center will identify the best overall quality unacceptable image for release.
c. An exception to the one released instance rule occurs when more than one acquisition was needed to cover all of the required anatomy, such as occurs for the bilateral screening knee in participants with

extreme varus deformity. In this case, each of two complementary images has its own unique barcode, and both will be released.

2.5.2 Knee MRI

a. Images with pending MRI-related queries will not be included in a release.
b. All unique and "accepted" instances (i.e., either a series of acceptable quality based on central QA review or one that was not selected for central QA review and was accepted by default without QA review) of an MRI series will be included in a release.
    i. Only one copy of each unique instance of an MRI series will be released (i.e., exact duplicates of the same instance of a series will be deleted).
    ii. Unacceptable quality (based on central QA review) instances of a series will not be released, except when there is no "accepted" instance of that series. In that case, all unacceptable quality instances of that series will be released. In such cases, careful examination of the available images should be undertaken to determine which one should be analyzed, keeping in mind that sometimes both may be sub-optimal and need to be analyzed together. The central imaging QA center will attempt to exclude partial or aborted series from a release when a complete series is available. This rule can be broken where there is a Sagittal DESS acquired with the scanner gradients out of specification on one date, but a repeated Sagittal DESS of the same knee acquired with the scanner gradients in specification on a later date (since the earlier scan is more appropriate for visual inspection and the later for quantitative measurements). In such cases, the earlier scan may have an unacceptable rating and the later scan an acceptable rating.

3. DICOM INFORMATION IN IMAGES

The images have correctly specified DICOM Unique Identifiers (UIDs) for the correct relationships between Participant ID, Study, Series, and Image UIDs, and therefore it should be possible to import them into PACS or other DICOM viewing software that require DICOM standard conformance. The data have been tested using Conquest DICOM server software (http://www.xs4all.nl/~ingenium/dicom.html) and also with eFilm Workstation software (http://www.efilm.ca), but should also work properly with other DICOM software.

In addition, to correctly specified DICOM UIDs, a uniform set of additional DICOM tags have attempted to be provided.

3.1 Radiograph DICOM Tags

The following table lists the format of the specified DICOM header tags in the radiographs. When “(unchanged if digital)” is listed, then the additional information in the table entry is specifically for images acquired on film and then subsequently digitized.

DICOM Header Tags for X-Ray Images

DICOM Tag Number	DICOM Tag Name	Comments
(0008,0020)	StudyDate	(unchanged if digital) [exam date from TF] *e.g.* 20051001
(0008,0030)	StudyTime	(unchanged if digital) 000000
(0008,0050)	AccessionNumber	Synarc Barcode, *e.g.* 016601234567
(0008,0060)	Modality	(unchanged if digital “DX” or “CR”) RG = acquired on film and then digitized CR = computed radiography DX = digital radiography
(0008,0090)	ReferringPhysiciansName	Empty
(0008,1010)	StationName	Empty

DICOM Tag Number	DICOM Tag Name	Comments
(0008,1030)	StudyDescription	• Bilateral PA Fixed Flexion Knee: OAI^XRAY^[visit name]^KNEE • AP Pelvis: OAI^XRAY^[visit name]^PELVIS • Full Limb: OAI^XRAY^[visit name]^FULL LIMB • Unilateral PA Fixed Flexion Knee: OAI^XRAY^[visit name]^KNEE LEFT OAI^XRAY^[visit name]^KNEE RIGHT • PA Bilateral Hand: OAI^XRAY^[visit name]^HAND • PA Unilateral Hand: OAI^XRAY^[visit name]^HAND LEFT OAI^XRAY^[visit name]^HAND RIGHT • Lateral Knee: OAI^XRAY^[visit name]^LAT KNEE LEFT OAI^XRAY^[visit name]^LAT KNEE RIGHT [visit name] is either: “SCREENING VISIT”, “ENROLLMENT VISIT”, “12 MONTH VISIT”, “24 MONTH VISIT” , “36 MONTH VISIT”, “48 MONTH VISIT”, “72 MONTH VISIT”
(0008,103E)	SeriesDescription	Bilateral PA Fixed Flexion Knee AP Pelvis Full Limb PA Fixed Flexion Right Knee PA Fixed Flexion Left Knee PA Bilateral Hand PA Right Hand PA Left Hand Lateral Right Knee Lateral Left Knee
(0010,0010)	PatientsName	[ParticipantID prefixed with “OAI”] *e.g.* OAI9007827
(0010,0020)	PatientID	[ParticipantID, no prefix] *e.g.* 9007827
(0010,0030)	PatientsBirthDate	Empty
(0010,0040)	PatientsSex	O (DICOM for “other”)
(0010,1010)	PatientsAge	Empty
(0012,0050)	ClinicalTrialTimePointID	Screening P01, Enrollment V00 12 Month V01, 24 Month V03 36 Month V05, 48 Month V06, 72 Month V08
	ClinicalTrialTimePointDescription	Screening Visit Enrollment Visit (Baseline) 12 month Annual Visit 24 month Annual Visit 36 month Annual Visit 48 month Annual Visit 72 month Annual Visit
(0018,0015)	BodyPartExamined	KNEE, PELVIS, HAND, LEG

DICOM Tag Number	DICOM Tag Name	Comments
(0020,0010)	StudyID	(both film and digital) Bilateral PA Fixed Flexion Knee 1 AP Pelvis 3 Full Limb 6 PA Fixed Flexion Right Knee 7 PA Fixed Flexion Left Knee 8 PA Bilateral Hand 2 PA Right Hand 10 PA Left Hand 11 Lateral Right Knee 7 Lateral Left Knee 8
(0020,0011)	SeriesNumber	(unchanged if digital) 1

All private DICOM tags have been removed from the radiographs, as have any DICOM overlays containing unwanted information.

3.1.1 Note about pixel spacings in radiographs acquired and stored digitally:

For radiographs acquired and stored digitally (Modality “CR” or “DX” stored in DICOM header), the pixel sizes stored in the DICOM tag for PixelSpacing (0028,0030) and ImagerPixelSpacing (0018,1164) are the values written by the acquisition equipment. It is important to note that the values specified may only be approximate. The pixel size is always square with sides varying from 0.100mm to 0.200mm and depends on the acquisition site and type of radiographic exam, although full-limb radiographs will have larger pixel sizes. There are two situations where PixelSpacing and ImagerPixelSpacing may contain different values.

The first situation is when the precision used to write the value into the fields is slightly different – an example of this would be PixelSpacing (mm) containing “0.189\0.189” and ImagerPixelSpacing (mm) containing “0.188895\0.188895”. In these situations, the values are effectively the same, but we suggest that you use the value with the highest precision (0.188895 mm in this case).

The second situation occurs when the X-Ray equipment has attempted to estimate both source to detector distance and source to patient distance, in which case ImagerPixelSpacing will be larger than PixelSpacing. An example of this would be if PixelSpacing (0028,0030) is “015796\0.15796” and ImagerPixelSpacing (0018,1164) is “0.168960\0.168960”, and in these cases, the value for PixelSpacing has usually been estimated by the equipment using the values from the DICOM header tags (0018,1110) DistanceSourceToDetector, DistanceSourceToPatient (0018,1111) in combination with ImagerPixelSpacing. It is important to note that since DistanceSourceToPatient is not well known and is only approximate, the value for pixel spacing does not necessarily relate to the actual size of the anatomy being imaged.

For X-Ray images in which DistanceSourceToDetector and DistanceSourceToPatient are recorded, the following equation should relate those values with ImagerPixelSpacing and PixelSpacing tags:

$$\frac{[\text{ImagerPixelSpacing}]}{[\text{PixelSpacing}]} = \frac{[\text{DistanceSourceToDetector}]}{[\text{DistanceSourceToPatient}]}$$

Equipment manufacturers may or may not complete all 4 fields, but the above equation shows the relationship between the 4 values. Please note, that for most X-Rays, no information is provided about the distances from the source to either detector or patients and imager pixel spacing and pixel spacing contain effectively the same information – the spacing between the centers of each pixel at the detector plane.

It is important to note that pixel sizes for the anatomy being imaged are always difficult to estimate due to magnification effects related to spacing between the relevant anatomy, the X-Ray source and the position of the detector. We encourage you to use the Synaflexer Frame described in Section 2.2.1 for cross calibration of fixed flexion knee radiographs between visits and between participants.

Important Note: In particular, the distance between the metal beads should always measure to be larger than 1” (25.4mm). For some CR and DX radiographs, manufacturers put estimated values for pixel spacing, but

those are not calibrated in anyway, and may assume that the knee is much further from the detector than it actually is. In those cases, incorrect use of the DICOM Tag PixelSpacing, rather than ImagerPixelSpacing may suggest that the metal beads are closer than 1" apart.

3.1.2 Note about pixel spacings in radiographs acquired on film and then digitized:

For radiographs digitized from film (Modality "RG" stored in DICOM header), the 3 different film digitizers used were set to a nominal pixel size of 0.100mm, but each of the digitizers used had the actual pixel size at that setting estimated. The value stored in the DICOM Tags PixelSpacing (0028,0030) and ImagerPixelSpacing (0018,1164) in an image is set to that actual pixel size for the digitizer used. For such OAI images the values are either "0.100\0.100", "0.101\0.101", or "0.102\0.102" mm. The same caveats mentioned in the previous section, regarding pixel spacings and the separations between anatomy, film and x-ray source affecting measurements taken from x-rays, also apply to images digitized from film.

3.1.3 Note about pixel spacings in radiographs acquired digitally, then printed on film:

A small subset of the X-Ray images for participants from site E, which were obtained from approximately 04/01/2005 thru 03/15/2006, were acquired digitally, printed on film, and then digitized. The pixel spacings stored in the DICOM headers represent the values from the digitization of the film. A total of about 140 images are of this type. These may get replaced by their CR image in future image releases. Once again, for fixed flexion knee radiographs, the Synaflexer frame can be used to calibrate such images.

3.2 MRI DICOM Tags

Table 2: DICOM Header Tags for MR Images

DICOM Tag Number	DICOM Tag Name	Comments
(0008,0020)	StudyDate	Unchanged
(0008,0030)	StudyTime	Unchanged
(0008,0050)	AccessionNumber	Synarc Barcode, *e.g.* 016601234567
(0008,0090)	ReferringPhysiciansName	Empty
(0008,1030)	StudyDescription	OAI^MR^[visit name]^LEFT OAI^MR^[visit name]^RIGHT OAI^MR^[visit name]^THIGH [visit name] is "ENROLLMENT VISIT", "12 MONTH VISIT", "18 MONTH VISIT", "24 MONTH VISIT", "30 MONTH VISIT" , or "36 MONTH VISIT", "48 MONTH VISIT", "72 MONTH VISIT"

DICOM Tag Number	DICOM Tag Name	Comments
(0008,103E)	SeriesDescription	SAG_3D_DESS_RIGHT COR_T1_3D_FLASH_RIGHT SAG_T2_MAP_RIGHT SAG_T2_CALC_RIGHT SAG_IW_TSE_RIGHT COR_IW_TSE_RIGHT COR_MPR_RIGHT AX_MPR_RIGHT SAG_3D_DESS_LEFT COR_T1_3D_FLASH_LEFT SAG_T2_MAP_LEFT SAG_T2_CALC_LEFT SAG_IW_TSE_LEFT COR_IW_TSE_LEFT COR_MPR_LEFT AX_MPR_LEFT MP_LOCATOR_RIGHT MP_LOCATOR_LEFT AX_T1_THIGH PRESCRIPTION_THIGH MP_LOCATOR_THIGH
(0008,1050)	PerformingPhysiciansName	Empty
(0008,1060)	NameOfPhysiciansReadingStudy	Empty
(0010,0010)	PatientsName	[ParticipantID prefixed with “OAI”] *e.g.* OAI9007827
(0010,0020)	PatientID	[ParticipantID, no prefix] *e.g.* 9007827
(0010,0030)	PatientsBirthDate	Empty
(0010,0040)	PatientsSex	O (DICOM for “other”)
(0010,1010)	PatientsAge	Empty
(0012,0050)	ClinicalTrialTimePointID	Enrollment V00, 12 Month V01, 18 Month V02, 24 Month V03, 30 Month V04, 36 Month V05 48 Month V06, 72 Month V08
(0012,0051)	ClinicalTrialTimePointDescription	Enrollment Visit (Baseline), 12 month Annual Visit, 18 month Interim Visit, 24 month Annual Visit, 30 month Interim Visit, 36 month Annual Visit, 48 month Annual Visit, 72 month Annual Visit
(0018,0015)	BodyPartExamined	Unchanged
(0018,1030)	ProtocolName	Unchanged
(0020,0010)	StudyID	Unchanged
(0020,0011)	SeriesNumber	Unchanged
(0020,0060)	Laterality	Unchanged

All private tags, including those added during central image QA have been cleared from the image files. Manufacturer-defined private tags have been retained, since their contents are known.

4. ACKNOWLEDGEMENTS

The DICOM tags for all images were processed using the program "dcmodify", and the DICOMDIR data files were created using the program "dcmmkdir". Both programs are part of the DCMTK DICOM ToolKit by the OFFIS Computer Science Institute (http://www.dcmtk.org/)

5. REFERENCES

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APPENDIX: Knee MR Image Acquisition Parameters

Property	MP_LOCATOR	COR_IW_TSE	SAG_3D_DESS	SAG_IW_TSE_FS	COR_T1W_3DFLASH_WE	SAG_T2_MAP
Weighting	**T1W**	**Int**	**T2***	**Int**	**T1W**	**T2 Map**
Plane	3-plane	Coronal	Sag	Sagittal	Coronal	Sagittal
Fat Sat	No	No	WE	Yes	WE	No
Matrix (phase)	256	307	307	313	512	269
Matrix (freq)	512	384	384	448	512	384
No. of slices	21	41	160	37	80	21
FOV (mm)	200	140	140	160	160	120
Slice thickness (mm)	5	3	0.7	3	1.5	3
Skip (mm)	1	0	0	0	0	0.5
Flip Angle (deg)	40	180	25	180	12	n/a
TE/TI (ms)	5	29	4.7	30	7.57	10, 20, 30, 40, 50, 60, 70
TR (ms)	10	3850	16.3	3200	20	2700
BW (Hz/pixel)	250	352	185	248	130	250
Chemical Shift (pixels)	1.8	1.3	0	0	0	1.8
NAV (NEX)	1	1	1	1	1	1
Echo train length	1	7	1	5	1	1
Phase Encode Axis	A/P, R/L	R/L	A/P	S/I	R/L	A/P
Phase Partial Fourier (8/8 = 1)	1	1	1	1	1	1
Readout Partial Fourier (8/8 = 1)	1	1	1	1	1	1
Slice Partial Fourier (8/8 = 1)	1	1	0.75	1	0.75	0.75
Options:		elliptical k-space filter and large FOV filter	elliptical k-space filter, elliptical sampling, large FOV filter	elliptical k-space filter and large FOV filter	elliptical scanning, elliptical k-space filter, larger FOV filter	elliptical k-space filter and large FOV filter
Distance Factor (%)	50	0	0	0	0	16
Phase Oversampling	0	20	0	40	0	0
Slice Oversampling	0	0	10	0	0	0
Phase Resolution	50	80	80	70	100	70
Averaging Technique	Short Term	Short Term	Short Term	Short Term	Short Term	Short Term
Gradient Rise Time	Fast	Fast	Fast	Fast	Fast	Fast

Property	MP_LOCATOR	COR_IW_TSE	SAG_3D_DESS	SAG_IW_TSE_FS	COR_T1W_3DFLASH_WE	SAG_T2_MAP
RF Amplitude	Normal	Normal	Fast	Normal	Fast	Normal
X-Resolution (mm)	0.391	0.365	0.365	0.357	0.313	0.313
Y-Resolution (mm)	0.781	0.456	0.456	0.511	0.313	0.446
Scan time (min)	**0.5**	**3.4**	**10.6**	**4.7**	**8.6**	**10.6**