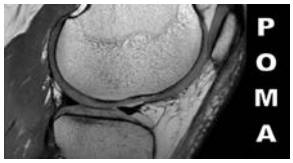


Pivotal OAI MR Imaging Analyses (POMA) study POMA: Quantitative Measurements of Cartilage Morphology from knee MRI Scans (Felix Eckstein: Chondrometrics and Paracelsus)

1. Overview

1.1 SAS datasets

Name: **kMRI_POMA_TKR_Chondrometrics**
Display label: **kMRI TKR reading (POMA, Chondrometrics)**

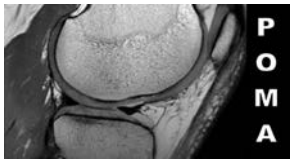
1.2 Contents of dataset

This dataset contains centrally performed measurements of cartilage volume and thickness from serial knee MRI scans performed by Dr. Felix Eckstein's group[1-4] in Germany (Chondrometrics, Gmbh, Ainring) or Austria (Paracelsus University, Salzburg) http://www.chondrometrics.com/. The knees in this analysis are taken from the Osteoarthritis Initiative (OAI) and read for the Pivotal OAI MR Imaging Analyses study[5-7] (POMA https://www.niams.nih.gov/funding/Funded_Research/Osteoarthritis_Initiative/pivotal_mri.asp).

In these datasets, knees have multiple records – one per visit read. Individual knees are identified by the variables ID and SIDE (as in other OAI image assessment datasets). The visit for which the readings are associated are identified by the variable VISIT as follows

- VISIT=0 OAI Visit V00 (baseline)
- VISIT=1 OAI Visit V01 (12-month follow-up)
- VISIT=3 OAI Visit V03 (24-month follow-up)
- VISIT=5 OAI Visit V05 (36-month follow-up)
- VISIT=6 OAI Visit V06 (48-month follow-up)

To combine with OAI clinical datasets, merge based on ID. To merge with visit-specific OAI datasets, the merge has to take into account ID, SIDE and VISIT. For example, to merge on Kellgren and Lawrence Grades (from OAI datasets kXR_SQ_BUxx), records with WAVE=BL need merging with kXR_SQ_BU00



based on ID and SIDE, records with VISIT=1 need merging with kXR_SQ_BU01 based on ID and SIDE, etc.

To merge POMA TKR OA cohort MOAKS data with quantitative measurements of cartilage volume/thickness, the dataset kMRI_POMA_TKR_CHONDROMETRICS can be merged with the dataset kMRI_POMA_TKR_MOAKS_BICL on ID, SIDE and VISIT.

1.3 Condition

- Known data errors: none at present.
- Dataset strengths/weaknesses:
    - These datasets contains one row of data (record) for a given knee per visit which needs to be taken into account when merging it with other datasets. Please see the "*Overview and Description of Central Image Assessments*" document for more information on merging.
    - Since this dataset contains one record per knee per visit, carefully read the previous section of this document for additional information about merging with other OAI datasets.
- These data/variables are not included in the variable files, but measurements from most knees/ visits have been exported to the kMRI_QCART_ECKSTEIN00, 01, 03, 05 datasets (records in those datasets with READPRJ="66").

1.4 Variables and reading methods

A complete listing of the variables in these datasets can be found in the documentation provided with the dataset, including variable names, descriptive variable labels and attributes.

Sections 2 and 3 describe the samples analyzed for the POMA TKR cohort and vTKR cohort respectively.

1.4a Technique for segmenting articular cartilage from the MR images

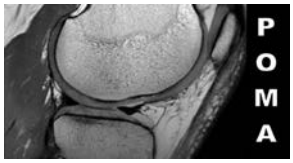
Measurements of volumes, thickness and areas of articular cartilage and subchondral bone are provided and are for a specific anatomic location in the knee (cartilage plates and/or subregions).

These publications give more details about the methods used by Dr. Felix Eckstein's group (Chondrometrics Gmbh, Ainring, Germany and Paracelsus University, Salzburg, Austria) for generating the data in these datasets:

- *Eckstein F, et al. One year change of knee cartilage morphology in the first release of participants from the Osteoarthritis Initiative Progression Subcohort - association with sex, Body Mass Index, symptoms, and radiographic OA status. Ann Rheum Dis. 2008 Jul 7. PMID: 18789729* http://dx.doi.org/10.1136/ard.2008.089904
- *Wirth W, et al. Regional analysis of femorotibial cartilage loss in a subsample from the Osteoarthritis Initiative progression subcohort. Osteoarthritis Cartilage. 2009; 17(3): 291-297.* http://dx.doi.org/10.1016/j.joca.2008.07.008

The following brief overview of the methods uses standard labeling nomenclature for describing MRI-based measures of articular cartilage in OA:

- the anatomical location (cartilage plates and their subregions) in the knee (e.g. MT for entire medial tibia)
- the structural feature being measured, consisting of a metric and a tissue label (e.g. ThCtAB for cartilage thickness over the entire subchondral bone area)
- when relevant, computational and statistical aspects of the structural metric (e.g. cartilage thickness in a specific location could be described by a mean value, a minimum value, a maximum value or a standard deviation)



These publications are recommended for further explanation of the standard labeling nomenclature:

- *Eckstein F et al. Proposal for a nomenclature for magnetic resonance imaging based measures of articular cartilage in osteoarthritis. Osteoarthritis Cartilage 2006;14:974-983.* http://dx.doi.org/10.1016/j.joca.2006.03.005
- *Wirth W., Eckstein F. A technique for regional analysis of femorotibial cartilage thickness based on quantitative magnetic resonance imaging. IEEE Trans Med Imaging. 2008;27(6):737-44.* http://dx.doi.org/10.1109/TMI.2007.907323

The main cartilage plates and subregions are outlined below and shown in figures 1 and 2.

1.4b Main cartilage plates
The following table shows the main cartilage plates analyzed for sagittal MR images (also see Figure 1).

Label	Description
MT	medial tibia [BLUE in Fig. 2, top]: entire plate, analysis of all slices in which MT is depicted
MF	entire medial femoral condyle
cMF	central (weight-bearing) medial femoral condyle defined based on 75% of the distance between trochlear notch and posterior end of femoral condyle
LT	lateral tibia [GREEN in FIG. 2, top]: entire plate, analysis of all slices in which LT is depicted
LF	entire lateral femoral condyle
cLF	central weight-bearing lateral femoral condyle defined based on 75% of the distance between trochlear notch and posterior end of femoral condyle

Note: the definition of the central (weight bearing) part of femoral condyles is given in: *Eckstein F, et al. Double echo steady state magnetic resonance imaging of knee articular cartilage at 3 Tesla: a pilot study for the Osteoarthritis Initiative. Ann Rheum Dis 2006;65:433-441)*: and represents 60% of the slices between the trochlear notch (anteriorly) and the posterior end of the femoral condyles.
http://dx.doi.org/10.1136/ard.2005.039370

Please note that for this study, the 60% definition of cMF and cLF are used.

Paper1: One year change of knee cartilage morphology in the first release of participants from the Osteoarthritis Initiative progression subcohort: association with sex, body mass index, symptoms and radiographic osteoarthritis status
Paper2: Regional analysis of femorotibial cartilage loss in a subsample from the Osteoarthritis Initiative progression subcohort

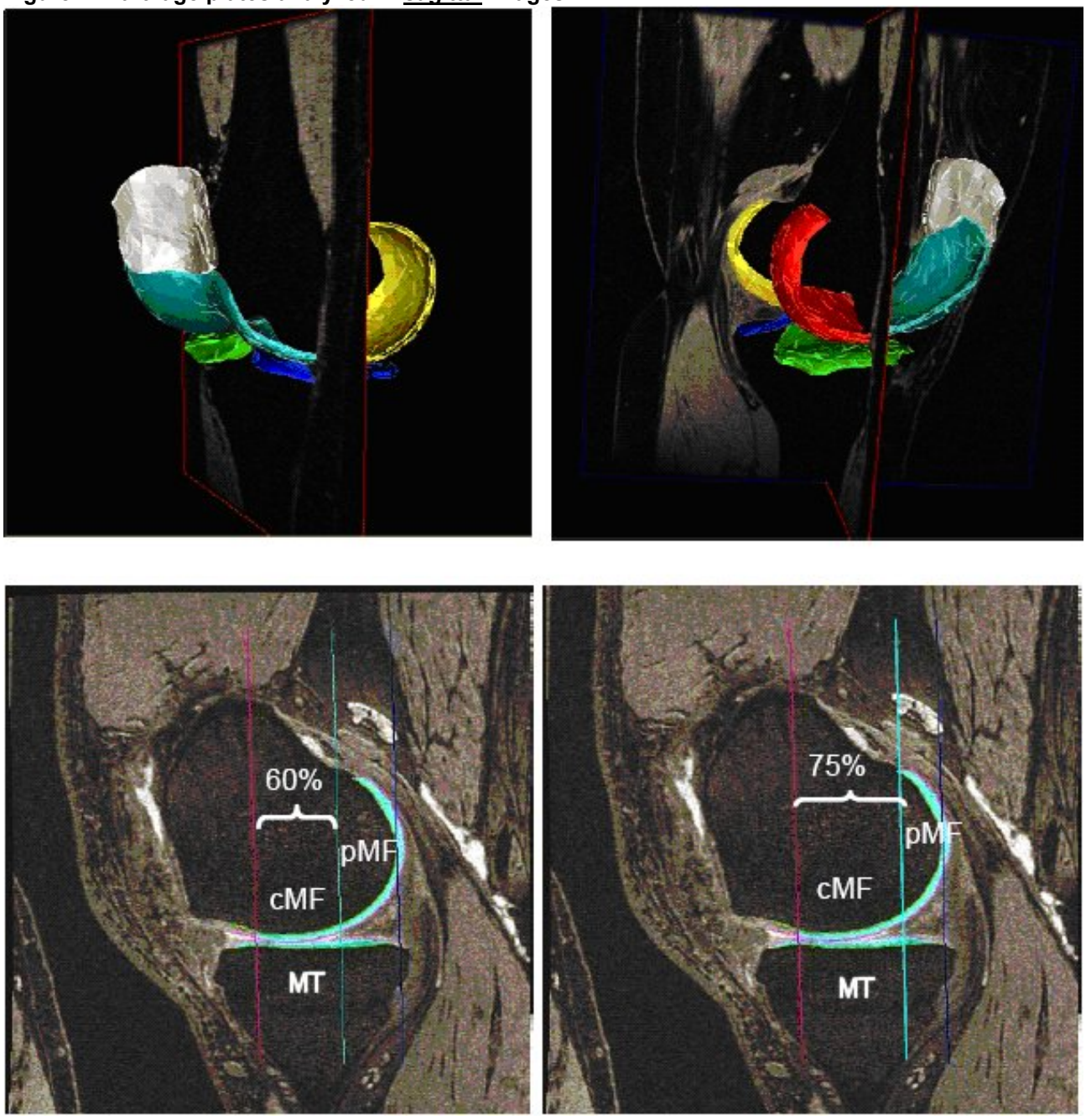
1.4c Subregions of main cartilage plates
This table shows the subregions analyzed in the medial tibio-femoral condyle cartilage plates (also see Figure 2) for analysis of both coronal and sagittal images:

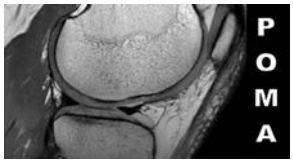
Label	Description
cMT	central subregion of medial tibia (20% of tAB) *
eMT	external subregion of medial tibia
iMT	internal subregion of medial tibia
aMT	anterior subregion of medial tibia
pMT	posterior subregion of medial tibia
ccMF	central subregion of central (weight-bearing) medial femur (33% of tAB)
ecMF	external subregion of central (weight-bearing) medial femur (33% of tAB)
icMF	Internal subregion of central (weight-bearing) medial femur (33% of tAB)

cMFTC	central medial femoro-tibial compartment [+]
* see next section for definition of tAB [+] this subregion is an aggregate of values for cMT and ccMF (cMT + ccMF)	

An analogous set of subregions is analyzed in the lateral tibio-femoral cartilage plates (also see Figure 2).

Figure 1: Cartilage plates analyzed in sagittal images.

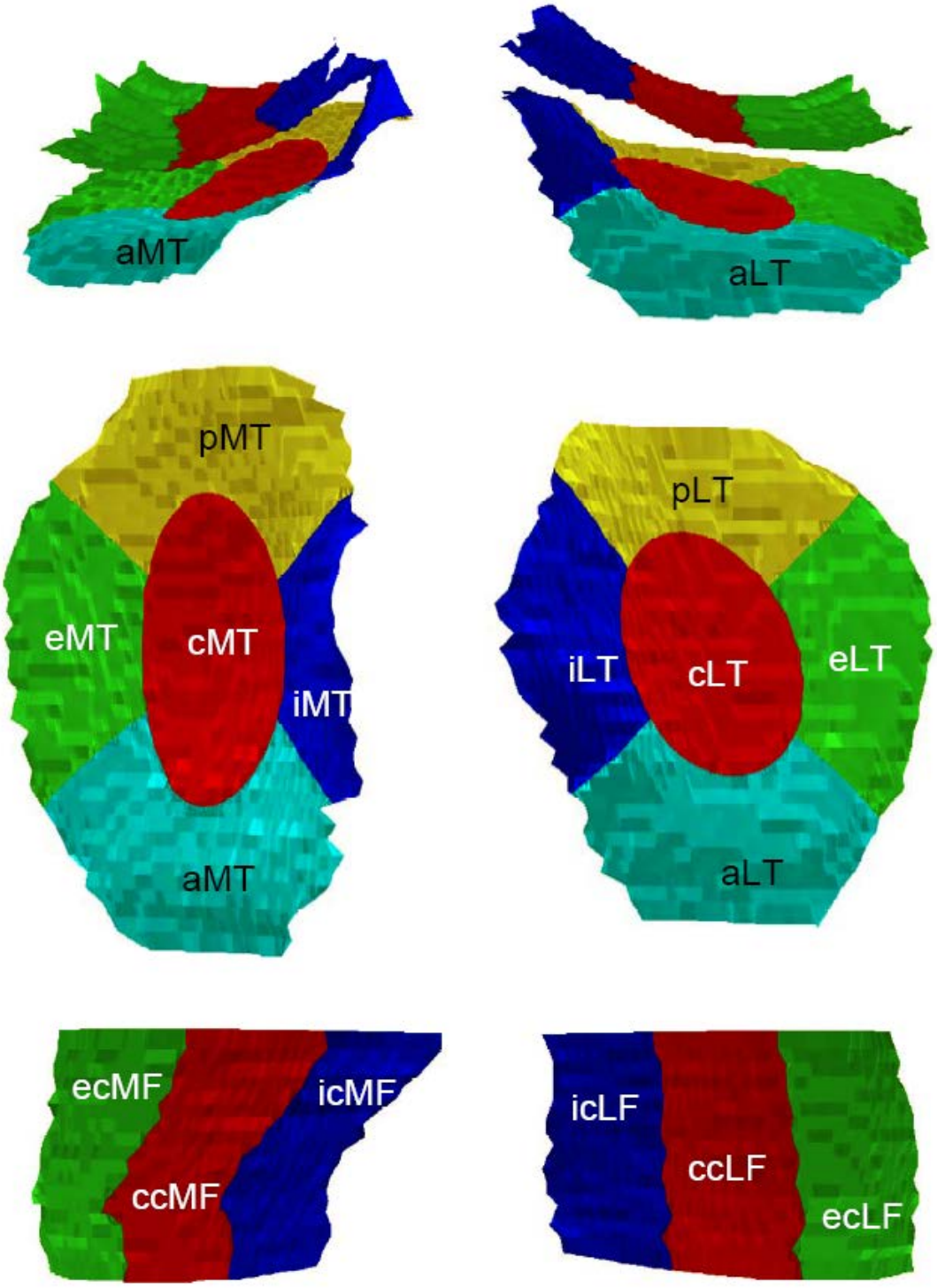




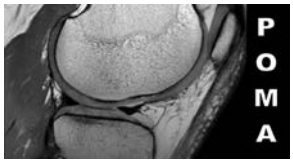
Top Row: The images show 3D reconstructions of the cartilage plates:
MT = medial tibia = blue; MF = medial femoral condyle = yellow
LT = lateral tibia = green, LF = lateral femoral condyle = red

Bottom Row: The images show sagittal MR images (DESSwe sequence) with the cartilage of MF being divided (turquoise line) into cMF and pMF at 60% (left) and 75% (right) of the distance between the trochlear notch (magenta colored line) and the posterior end of the femoral condyle (blue line). Note that the magenta colored line is oriented parallel to the femoral shaft and through the trochlear notch in a central slice between MF and LF (not in the slice shown here) and that the posterior ends of MF and LF are determined in slices depicting the most posterior aspects of MT and LF, respectively.

Figure 2: Subregions of tibio-femoral cartilage plates.



Top Row: Subregions of MT, LT, cMF and cLF, view from anterior
Middle Row: Subregions of MT & LT, view from superior
Bottom Row: Subregions of cMF & cLF, view from inferior



1.4d Structural features and metrics
This table shows the measurements of structural features and metrics provided for various cartilage plates and subregions (also see Figure 3).

Label	Unit	Description
VC	(mm^3)	cartilage volume (computed by numerical voxel integration)
tAB	(cm^2)	total area of subchondral bone
AC	(cm^2)	area of cartilage surface
cAB	(cm^2)	area of subchondral bone covered by cartilage
dAB%	(%)	% area of subchondral bone denuded of cartilage
VCtAB	(mm)	cartilage volume divided by tAB (normalized cartilage volume)
ThCtAB	(mm)	cartilage thickness over tAB
ThCcAB	(mm)	cartilage thickness over cAB

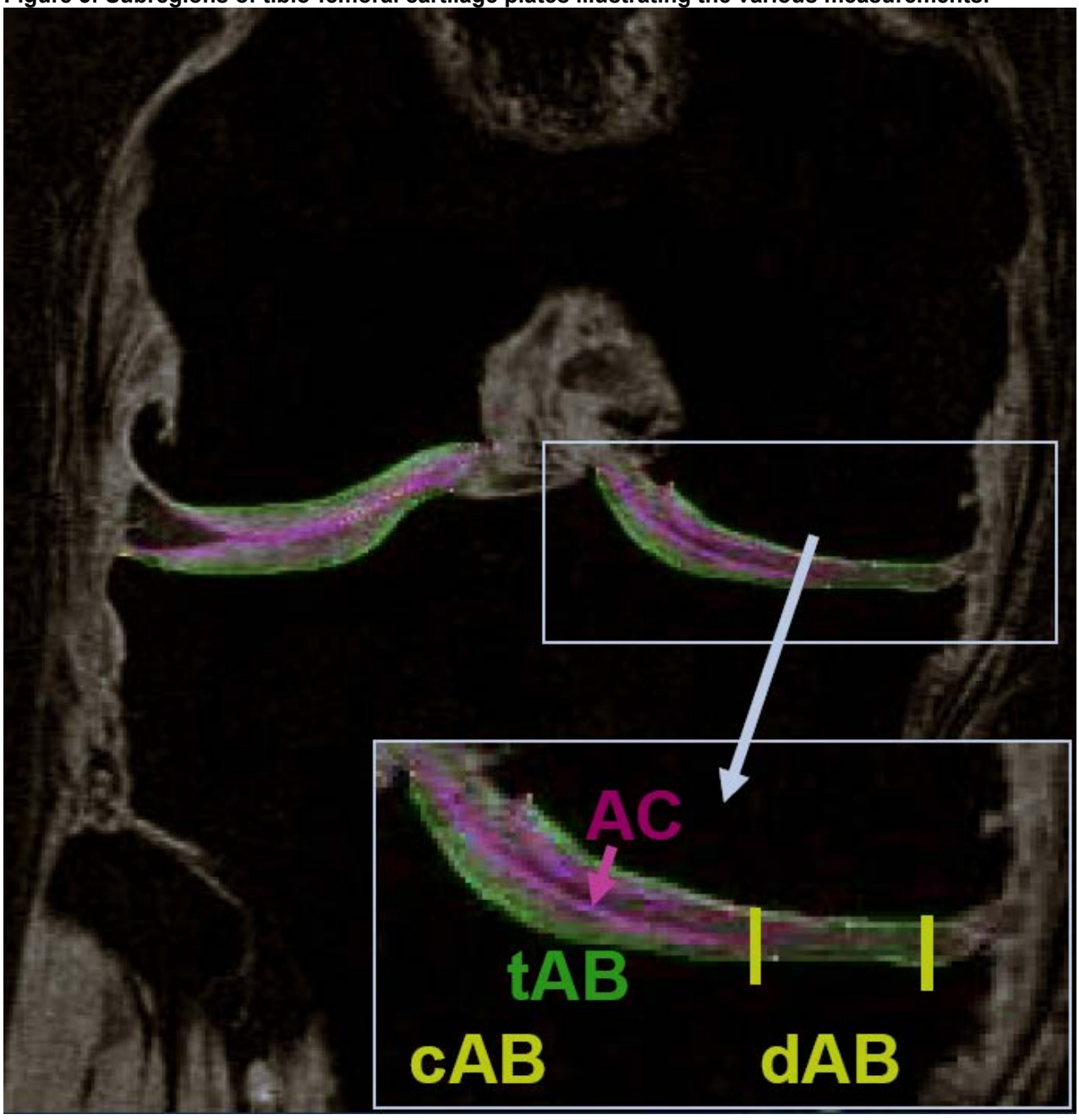
Note: volumes have been computed by numerical voxel integration and not after surface reconstruction in cases where cAB = tAB (no denuded area present), ThCcAB = ThCtAB.

1.4e Computational details for cartilage thickness (ThC) metrics
Cartilage thickness measurements are summaries of the metric over a specific area of a cartilage plate or a subregion. These summaries can be calculated in several different ways. The bold portion of the description is used in our documentation and is related to the short abbreviated form used in various Eckstein publications, as outlined below.

Label	Description
aMe	**mean cartilage thickness** = the algorithm computes the average of two distances: distance from AC to tAB (c) and from tAB to AC (b), respectively.
aMiv	**minimum cartilage thickness** = mean of the 1% of lowest thickness values over a given area. Because in all peripheral regions the cartilage thickness drops off to zero at the margins, this variable is used only for cMT, ccMF, cLT and ccLF. The reason for not taking a single minimal measurement (min), but an average (1% lowest values in region) is the higher precision of Miv versus Min.
aMav	**maximum cartilage thickness** = mean of the 1% of highest thickness values over a given area. The reason for not taking a single maximal measurement (max), but an average (1% highest values in region) is the higher precision of Mav versus Max
SD	**SD of cartilage thickness** = standard deviation of cartilage thicknesses over a given area. This is a measure of the variation in cartilage thickness over a given area.
CV	**CV% of cartilage thickness** = coefficient of variation of cartilage thickness over a given area. This is a measure of the variation in cartilage thickness over a given area, i.e. CV% = 0 = uniform cartilage thickness.

Note: other OAI datasets may use similar descriptions (e.g.: “mean cartilage thickness” or “minimum cartilage thickness”) and although the measurements may be similar, differences in the algorithms used to calculate them should be taken into account when comparing techniques and measurements.

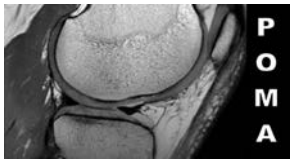
Figure 3: Subregions of tibio-femoral cartilage plates illustrating the various measurements.



The left image shows segmentations of the AC (magenta) and of the tAB (green) and how the tAB is separated by AC into cAB and dAB.

Please note that in cases where AC covers the entire tAB (no denuded area) cAB is equal to tAB. Cartilage thickness (ThC) may be computed for the cAB only (ThCcAB) or over the entire tAB (ThCtAB), with the dAB being included as 0 mm cartilage thickness.

In cases where cAB = tAB (no denuded area present), ThCcAB = ThCtAB.



1.4f. SAS variable names

A complete listing of the variables in these datasets can be found in the documentation provided with the dataset, including SAS variable names, descriptive variable labels and attributes.

SAS variable names in this dataset follow these conventions:

- The first part of the variable name (before any '_') denotes the anatomical location (see table in section 1.4c for more information, e.g.: MT = medial tibial plateau).
- The ending of the name (after the first '_') defines the structural feature/metric. (e.g. VC = volume of cartilage).

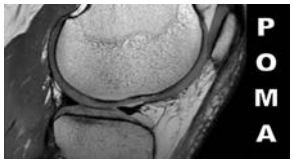
For this dataset, the following table shows the relationship between the end of the SAS variable name and its corresponding structural feature. The combination of the standard nomenclature information in the variable name and label/description help to determine what measurement a specific variable represents.

Ending of SAS Variable Name	Structural features and metrics	
	Label[1]	**Description**
VC	VC	cartilage volume
tAB	tAB	total area of subchondral bone
AC	AC	area of cartilage surface
cAB	cAB	area of subchondral bone covered by cartilage
dAPp	dAB%	% area of subchondral bone denuded of cartilage
VCtAB	VCtAB	normalized cartilage volume (cartilage volume divided by tAB)
ThCtAB_aMe	ThCtAB.aMe	mean cartilage thickness over tAB
ThCcAB_aMe	ThCcAB.aMe	mean cartilage thickness over cAB
ThCtAB_aMav	ThCtAB.aMav	maximum cartilage thickness over tAB
ThCtAB_aMiv	ThCtAB.aMiv	minimum cartilage thickness over tAB
ThCtAB_aSD	ThCtAB.aSD	standard deviation (SD) of cartilage thickness over tAB
ThCtAB_aCV	ThCtAB.aCV	coefficient of variation (CV) of cartilage thickness over tAB

[1] Label proposed in *Eckstein F et al. Proposal for a nomenclature for magnetic resonance imaging based measures of articular cartilage in osteoarthritis. Osteoarthritis Cartilage 2006;14:974-983.* http://dx.doi.org/10.1016/j.joca.2006.03.005

Note: Section 1.4e describes the differences and methods of calculating the different cartilage thickness metrics.

Also note that not all structural features exist for each anatomical location and not all anatomical locations are analyzed for all the projects in this dataset, so some records will have missing values.



2. Methods & Selection for POMA Readings

2.1 Image type:
Knee MRI scans acquired using a 3D Sagittal DESS sequence. For the details of the MRI acquisition protocol used, see the "*MRI Manual*" document in the operation manuals.

2.2 Time point:
Baseline, 12-month, 24-month, 36-month, and 48-month visits.

2.3 Measurement methods:
Publically released OAI images were selected and sent to Chondrometrics for analysis by the POMA Study (Pivotal Osteoarthritis Initiative Magnetic Resonance Imaging Analyses Study https://www.niams.nih.gov/funding/Funded_Research/Osteoarthritis_Initiative/pivotal_mri.asp) with the reading center blinded to case/control selection for that study.

60%

~~**For POMA, the femoral regions (cMF and cLF) were defined using 75% of the distance between the trochlear notch and the posterior of the femoral condyle (see Figure 2 above).**~~

Paper1: One year change of knee cartilage morphology in the first release of participants from the Osteoarthritis Initiative progression subcohort: association with sex, body mass index, symptoms and radiographic osteoarthritis status
Paper2: Regional analysis of femorotibial cartilage loss in a subsample from the Osteoarthritis Initiative progression subcohort

2.4 Variables:
The following parameters are measured in the main cartilage plates (section 1.4b) and subregions (section 1.4c):

- cartilage volume (VC) by numerical voxel integration
- total area of subchondral bone (tAB)
- area of cartilage surface (AC)
- area of subchondral bone covered by cartilage (cAB)
- % area of subchondral bone denuded of cartilage (dAB%)
- normalized cartilage volume (VCtAB) which is AC/tAB
- cartilage thickness over the tAB area (ThCtAB)
- cartilage thickness over the cAB area (ThCcAB)

See section 1.4d for more information about these parameters.

A complete listing of the variables in these datasets can be found in the documentation provided with the dataset, including SAS variable names, descriptive variable labels and attributes.

2.5 Sample:
The knees studied in this dataset are from the Pivotal OAI MR Imaging Analyses (POMA) study, and in particular prediction of knee replacements. Further details about this study are provided on the study webpage at https://www.niams.nih.gov/funding/Funded_Research/Osteoarthritis_Initiative/pivotal_mri.asp.

The results from this analysis further details of their selection are in this publication[5]

- *Eckstein F, et al. Quantitative MRI measures of cartilage predict knee replacement: a case-control study from the Osteoarthritis Initiative. Ann Rheum Dis 2013;72(5):707-714. PMID: 22730370. https://doi.org/10.1136/annrheumdis-2011-201164*

but in summary, cohort consists of 450 knees selected for a nested, 1-to-1 matched case/control analysis. Cases were defined as knees that underwent a primary total knee replacement after the baseline visit, but before the 60-month visit. Controls were defined as knees that did not undergo knee replacement prior to the 60-month visit. Matching was on participant age (within five years), sex, and KL grade in both knees at the baseline visit. Selections were performed using the OAI Outcomes99 version 6 dataset.

3. References

1. Eckstein F, Maschek S, Wirth W, Hudelmaier M, Hitzl W, Wyman B, Nevitt M, Hellio Le Graverand MP. One year change of knee cartilage morphology in the first release of participants from the Osteoarthritis Initiative Progression Subcohort - association with sex, Body Mass Index, symptoms, and radiographic OA status. Ann Rheum Dis. 2008; 68(5): 674-679 PMID: 18519425 http://dx.doi.org/10.1136/ard.2008.089904

2. Wirth W, Hellio Le Graverand MP, Wyman BT, Maschek S, Hudelmaier M, Hitzl W, Nevitt M, Eckstein F Regional analysis of femorotibial cartilage loss in a subsample from the Osteoarthritis Initiative progression subcohort. Osteoarthritis Cartilage. 2009; 17(3): 291-297. http://dx.doi.org/10.1016/j.joca.2008.07.008

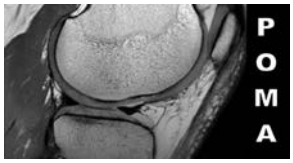
3. Eckstein F, Ateshian G, Burgkart R, Burstein D, Cicuttini F, Dardzinski B, et al. Proposal for a nomenclature for magnetic resonance imaging based measures of articular cartilage in osteoarthritis. Osteoarthritis Cartilage 2006;14:974-983. http://dx.doi.org/10.1016/j.joca.2006.03.005

4. Wirth W., Eckstein F. A technique for regional analysis of femorotibial cartilage thickness based on quantitative magnetic resonance imaging. IEEE Trans Med Imaging. 2008 Jun;27(6):737-44. http://dx.doi.org/10.1109/TMI.2007.907323

5. Eckstein F, et al. Quantitative MRI measures of cartilage predict knee replacement: a case-control study from the Osteoarthritis Initiative. Ann Rheum Dis 2013, 72(5): 707-714. PMID: 22730370. https://doi.org/10.1136/annrheumdis-2011-201164

6. Roemer F, et al. What comes first? Multitissue involvement leading to radiographic osteoarthritis: magnetic resonance imaging-based trajectory analysis over four years in the osteoarthritis initiative. Arthritis Rheumatol 2015, 67(8): 2085-2096. PMID: 25940308 PMCID: PMC4519416. https://doi.org/10.1002/art.39176

7. Roemer F, et al. Can structural joint damage measured with MR imaging be used to predict knee replacement in the following year? Radiology 2015, 274(3): 810-820. PMID: 25279436 PMCID: PMC4455669. https://doi.org/10.1148/radiol.14140991



Appendix – POMA Data Dictionary for Chondrometrics Measurements

Table 1. Non-measurement variables in the TKR dataset (kMRI_POMA_TKR_CHONDROMETRICS)

Variable Name	Variable Description	Value + Value Label
ID	ReleaseID	OAI Public ReleaseID
Side	Side	1: Right, 2: Left
Version	Version Number of dataset	
Visit	OAI Visit for MOAKS readings	0: Baseline 1: 12-month 3: 24-month 5: 36-month 6 48-month
class	Identification of Case/Control,	KR=Case, CONTROL=Control
Newstrata	Strata Variable for Case/Control Pairs	
tmpt	OAI Visit Following KR Surgery or matching:	0: Baseline 1: 12-month 3: 24-month 5: 36-month 6 48-month 7: 60-month

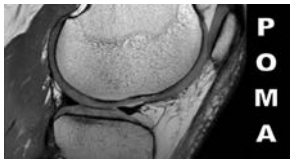
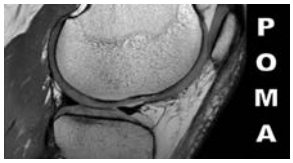
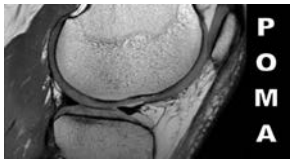


Table 2. Chondrometrics measurement variables in the all datasets

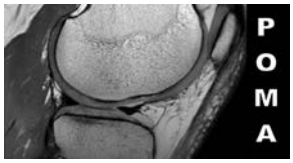
Variable Name	Variable Description	Value + Value Labels
MT_VC	Volume of Cartilage – Medial Tibia (mm3)	Continuous Number
MT_tAB	Total Area of Subchondral Bone – Medial Tibia (cm2)	Continuous Number
MT_VCtAB	Normalized Cartilage Volume – Medial Tibia (mm)	Continuous Number
MT_ThCtAB_aMe	Mean Cartilage Thickness – Medial Tibia (mm)	Continuous Number
MT_AC	Area of Cartilage Thickness – Medial Tibia (cm2)	Continuous Number
MT_dABp	Percentage of Area of Subchondral Bone Covered by Cartilage – Medial Tibia (cm2)	Continuous Number
MT_cAB	Area of Subchondral Bone Covered by Cartilage – Medial Tibia (cm2)	Continuous Number
MT_ThCcAB_aMe	Mean Cartilage Thickness – Medial Tibia (mm)	Continuous Number
MT_ThCtAB_aMav	Maximium Cartilage Thickness – Medial Tibia (mm)	Continuous Number
MT_ThCtAB_aSD	SD of Cartilage Thickness – Medial Tibia	Continuous Number
MT_ThCtAB_aCV	CV of Cartilage Thickness – Medial Tibia	Continuous Number
cMT_ThCtAB_aMiv	Minimum Cartilage Thickness – Medial Tibia (Center)	Continuous Number
cMT_ThCtAB_aMe	Mean Cartilage Thickness – Medial Tibia (Center)	Continuous Number
eMT_ThCtAB_aMe	Mean Cartilage Thickness – Medial Tibia (External)	Continuous Number
iMT_ThCtAB_aMe	Mean Cartilage Thickness – Medial Tibia (Internal)	Continuous Number
aMT_ThCtAB_aMe	Mean Cartilage Thickness – Medial Tibia (Anterior)	Continuous Number
pMT_ThCtAB_aMe	Mean Cartilage Thickness – Medial Tibia (Posterior)	Continuous Number
cMT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Medial Tibia (Central)	Continuous Number
eMT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Medial Tibia (External)	Continuous Number
iMT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Medial Tibia (Interior)	Continuous Number
aMT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Medial Tibia (Anterior)	Continuous Number
pMT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Medial Tibia (Posterior)	Continuous Number
cMF_VC	Volume of Cartilage – Central Medial Femur (mm3)	Continuous Number
cMF_tAB	Total Area of Subchondral Bone – Central Medial Femur (cm2)	Continuous Number
cMF_VCtAB	Normalized Cartilage Volume – Central Medial Femur (mm)	Continuous Number
cMF_ThCtAB_aMe	Mean Cartilage Thickness – Central Medial Femur (mm)	Continuous Number



cMF_AC	Area of Cartilage Thickness – Central Medial Femur (cm2)	Continuous Number
cMF_dABp	Percentage of Area of Subchondral Bone Covered by Cartilage – Central Medial Femur (cm2)	Continuous Number
cMF_cAB	Area of Subchondral Bone Covered by Cartilage – Central Medial Femur (cm2)	Continuous Number
cMF_ThCcAB_aMe	Mean Cartilage Thickness – Central Medial Femur (mm)	Continuous Number
cMF_ThCtAB_aMav	Maximium Cartilage Thickness – Central Medial Femur (mm)	Continuous Number
cMF_ThCtAB_aSD	SD of Cartilage Thickness – Central Medial Femur	Continuous Number
cMF_ThCtAB_aCV	CV of Cartilage Thickness – Central Medial Femur	Continuous Number
ccMF_ThCtAB_aMiv	Minimum Cartilage Thickness – Medial Tibia (Center)	Continuous Number
ccMF_ThCtAB_aMe	Mean Cartilage Thickness – Central Medial Femur (Center)	Continuous Number
ecMF_ThCtAB_aMe	Mean Cartilage Thickness – Central Medial Femur (External)	Continuous Number
icMF_ThCtAB_aMe	Mean Cartilage Thickness – Central Medial Femur (Internal)	Continuous Number
ccMF_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Weight-Bearing Medial Femur (Center)	Continuous Number
ecMF_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Weight-Bearing Medial Femur (External)	Continuous Number
icMF_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Weight-Bearing Medial Femur (Internal)	Continuous Number
MFTC_VC	Volume of Cartilage – Medial Tib-Fem Compartment (mm3)	Continuous Number
MFTC_VCtAB	Normalized Cartilage Volume – Medial Tib-Fem Compartment (mm)	Continuous Number
MFTC_ThCtAB_aMe	Mean Cartilage Thickness – Medial Tib-Fem Compartment (mm)	Continuous Number
MFTC_ThCtAB_aMav	Maximum Cartilage Thickness – Medial Tib-Fem Compartment (mm)	Continuous Number
cMFTC_ThCtAB_aMiv	Minimum Cartilage Thickness – Central Medial Tib-Fem Compartment (mm)	Continuous Number
cMFTC_ThCtAB_aMe	Mean Cartilage Thickness – Central Medial Tib-Fem Compartment (mm)	Continuous Number
MFTC_tAB	Total Area of Subchondral Bone – Medial Tib-Fem Compartment (mm)	Continuous Number
MFTC_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Medial Tib-Fem Compartment (mm)	Continuous Number
cMFTC_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Central Medial Tib-Fem Compartment (mm)	Continuous Number
LT_VC	Volume of Cartilage – Lateral Tibia (mm3)	Continuous Number



LT_tAB	Total Area of Subchondral Bone – Lateral Tibia (cm2)	Continuous Number
LT_VCtAB	Normalized Cartilage Volume – Lateral Tibia (mm)	Continuous Number
LT_ThCtAB_aMe	Mean Cartilage Thickness – Lateral Tibia (mm)	Continuous Number
LT_AC	Area of Cartilage Thickness – Lateral Tibia (cm2)	Continuous Number
LT_dABp	Percentage of Area of Subchondral Bone Covered by Cartilage – Lateral Tibia (cm2)	Continuous Number
LT_cAB	Area of Subchondral Bone Covered by Cartilage – Lateral Tibia (cm2)	Continuous Number
LT_ThCcAB_aMe	Mean Cartilage Thickness – Lateral Tibia (mm)	Continuous Number
LT_ThCtAB_aMav	Maximium Cartilage Thickness – Lateral Tibia (mm)	Continuous Number
LT_ThCtAB_aSD	SD of Cartilage Thickness – Lateral Tibia	Continuous Number
LT_ThCtAB_aCV	CV of Cartilage Thickness – Lateral Tibia	Continuous Number
cLT_ThCtAB_aMiv	Minimum Cartilage Thickness – Lateral Tibia (Center)	Continuous Number
cLT_ThCtAB_aMe	Mean Cartilage Thickness – Lateral Tibia (Center)	Continuous Number
eLT_ThCtAB_aMe	Mean Cartilage Thickness – Lateral Tibia (External)	Continuous Number
iLT_ThCtAB_aMe	Mean Cartilage Thickness – Lateral Tibia (Internal)	Continuous Number
aLT_ThCtAB_aMe	Mean Cartilage Thickness – Lateral Tibia (Anterior)	Continuous Number
pLT_ThCtAB_aMe	Mean Cartilage Thickness – Lateral Tibia (Posterior)	Continuous Number
cLT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Lateral Tibia (Center)	Continuous Number
eLT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Lateral Tibia (External)	Continuous Number
iLT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Lateral Tibia (Interior)	Continuous Number
aLT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Lateral Tibia (Anterior)	Continuous Number
pLT_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Lateral Tibia (Posterior)	Continuous Number
cLF_VC	Volume of Cartilage – Central Lateral Femur (mm3)	Continuous Number
cLF_tAB	Total Area of Subchondral Bone – Central Lateral Femur (cm2)	Continuous Number
cLF_VCtAB	Normalized Cartilage Volume – Central Lateral Femur (mm)	Continuous Number
cLF_ThCtAB_aMe	Mean Cartilage Thickness – Central Lateral Femur (mm)	Continuous Number
cLF_AC	Area of Cartilage Thickness – Central Lateral Femur (cm2)	Continuous Number
cLF_dABp	Percentage of Area of Subchondral Bone Covered by Cartilage – Central Lateral Femur (cm2)	Continuous Number



cLF_cAB	Area of Subchondral Bone Covered by Cartilage – Central Lateral Femur (cm2)	Continuous Number
cLF_ThCcAB_aMe	Mean Cartilage Thickness – Central Lateral Femur (mm)	Continuous Number
cLF_ThCtAB_aMav	Maximium Cartilage Thickness – Central Lateral Femur (mm)	Continuous Number
cLF_ThCtAB_aSD	SD of Cartilage Thickness – Central Lateral Femur	Continuous Number
cLF_ThCtAB_aCV	CV of Cartilage Thickness – Central Lateral Femur	Continuous Number
ccLF_ThCtAB_aMiv	Minimum Cartilage Thickness – Lateral Tibia (Center)	Continuous Number
ccLF_ThCtAB_aMe	Mean Cartilage Thickness – Central Lateral Femur (Center)	Continuous Number
ecLF_ThCtAB_aMe	Mean Cartilage Thickness – Central Lateral Femur (External)	Continuous Number
icLF_ThCtAB_aMe	Mean Cartilage Thickness – Central Lateral Femur (Internal)	Continuous Number
ccLF_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Weight-Bearing Lateral Femur (Center)	Continuous Number
ecLF_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Weight-Bearing Lateral Femur (External)	Continuous Number
icLF_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Weight-Bearing Lateral Femur (Internal)	Continuous Number
LFTC_VC	Volume of Cartilage – Lateral Tib-Fem Compartment (mm3)	Continuous Number
LFTC_VCtAB	Normalized Cartilage Volume – Lateral Tib-Fem Compartment (mm)	Continuous Number
LFTC_ThCtAB_aMe	Mean Cartilage Thickness – Lateral Tib-Fem Compartment (mm)	Continuous Number
LFTC_ThCtAB_aMav	Maximum Cartilage Thickness – Lateral Tib-Fem Compartment (mm)	Continuous Number
cLFTC_ThCtAB_aMiv	Minimum Cartilage Thickness – Central Lateral Tib-Fem Compartment (mm)	Continuous Number
cLFTC_ThCtAB_aMe	Mean Cartilage Thickness – Central Lateral Tib-Fem Compartment (mm)	Continuous Number
LFTC_tAB	Total Area of Subchondral Bone – Lateral Tib-Fem Compartment (mm)	Continuous Number
LFTC_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Lateral Tib-Fem Compartment (mm)	Continuous Number
cLFTC_dABp	Percentage of Area of Subchondral Bone Denuded by Cartilage – Central Lateral Tib-Fem Compartment (mm)	Continuous Number