

# PROCEDURE MANUAL FOR MROS

## VISIT 4 HR-PQCT EXAMS:

### SCANCO MEDICAL XTREMECT II

This manual is copyrighted 2014 by the University of California. Unauthorized copying or distribution is prohibited except with the written consent of UCSF Department of Radiology & Biomedical Imaging. All rights reserved.



*Protocol v0.7*

*02-FEB-2016*

*Department of Radiology & Biomedical Imaging*

# 1 Introduction

The purpose of this manual is to describe the HR-pQCT imaging quality assurance program for the clinical centers participating in the MrOS study. It provides information specific to the Scanco Medical XtremeCT II and is intended as a supplement to the Scanco Users' Manual.

To use this manual effectively, it is essential that to have read and understood the entire Scanco Medical XtremeCT II User's Manual. The study operators are required to have participated in a Scanco XtremeCT training session and should be familiar with all instrument features and procedures discussed in the Scanco Users' Manual.

During the study, any questions regarding procedures that arise should be directed to:

Andrew Burghardt  
Department of Radiology & Biomedical Imaging  
UCSF MC 2520  
QB3/Byers Hall, Suite 203  
San Francisco CA 94158-2330

Telephone: (415) 514-9658  
Fax: (415) 514-9656  
andrew.burghardt@ucsf.edu

**IMPORTANT: Unauthorized changes in scanner model, software or personnel can have a large impact on the integrity of study data. If, for any reason, changes in any of these areas are anticipated, please contact the HR-pQCT Quality Assurance Center in San Francisco in advance for further instructions.**

## 2 Study Logistics

HR-pQCT measurements will be acquired at VISIT 4. Scans will be made at the distal tibia, proximal tibia, and distal radius.

Followup HR-pQCT measurements will be acquired for a small sub-study at participating clinical centers.

### 2.1 Division of Quality Assurance Responsibilities

#### 2.1.1 Clinical center responsibilities

The clinical centers must ensure the overall quality and completeness of the HR-pQCT data and that all protocols and procedures are strictly followed. Specific responsibilities include the following:

1. Require that operators are properly trained and certified. If there are State requirements for CT operators, these must be met;
2. Identify a chief HR-pQCT operator to train and supervise other operators;
3. Perform and review daily QC scans;
4. Schedule and perform cross-calibration scans for a set of traveling phantoms;
5. Assure that proper archiving and back-up procedures for participant scans are performed and that archives are stored securely on appropriate archiving media until the end of the study;
6. Assure that proper database and OS back-up procedures are performed on a weekly and semi-annual basis, respectively.
7. Once a month, on or about the 15th, send the following materials to the Coordinating Center:
  - a. Database exports for the daily and weekly QC data
  - b. Updated list of participant scans and machine repair logs
8. Assure proper functioning of hardware/software and request service from Scanco;
  - a. Notify Scanco and the Coordinating Center of any machine or software problems
  - b. Record machine/software problems and service on the Scanco Repair/Service/Upgrade Log

- c. Perform 5 QC phantom scans before (if possible) and after service
  - d. Perform 5 QC phantom scans before and after machine relocation
9. Contact the Coordinating Center with any questions or problems that cannot be dealt with in the monthly batch mailings.

### 2.1.2 MrOS Quality Assurance Center responsibilities

The following are the responsibilities of the Coordinating Center:

1. Write and maintain the quality assurance manual;
2. Promptly review the QC phantom scan data received from each clinical center in order to identify surges or drifts in machine performance;
3. Promptly review the patient scan data received from each clinical center for image quality and positioning errors;
4. Incorporate new participant data into the study wide database;
5. Review certification and flagged scans and report findings to each clinical center;
6. Arrange for cross-calibration of all HR-pQCT instruments using traveling phantoms;
7. Prepare quality control summary reports for MrOS Steering Committee review;
8. Identify possible sources of error, and suggest possible solutions (**however, the Coordinating Center will not be responsible for the solution of a hardware or software problem; that will rest with the clinical center and Scanco**);
9. Review and evaluate special purpose phantom scans;

Any questions or correspondence regarding the manual or the technical aspects of the HR-pQCT measurements should be directed to:

Andrew Burghardt  
Department of Radiology & Biomedical Imaging  
UCSF MC 2520  
QB3/Byers Hall, Suite 203

San Francisco CA 94158-2330

Telephone: (415) 514-9658

Fax: (415) 514-9656

[andrew.burghardt@ucsf.edu](mailto:andrew.burghardt@ucsf.edu)

## 2.2 Training and Certification of MrOS HR-pQCT Operators

To obtain consistent results, the HR-pQCT operators must be aware of possible sources of error that may affect data collection and analysis. Only those operators who have been certified through Scanco training and the Coordinating Center review are allowed to perform the scanning for this study.

Anyone performing scans for the MrOS study must meet the following requirements:

1. Read and understand both the Scanco XtremeCT II manual and this manual;
2. Successfully complete a Scanco XtremeCT II training session;
3. Successfully complete Coordinating Center's positioning and image quality training exercises;
4. Satisfactory review of each operator's initial scans by the Coordinating Center.

In order for an individual operator to be certified to perform scans of a given skeletal site, the first 10 scans done on study participants at each skeletal site for each operator must be reviewed by the Coordinating Center.

It is the clinical center's responsibility to ensure that all of the above certification criteria are met as new operators are brought into the study. Because the Scanco training sessions can be organized infrequently, there may be several months of delay between when a new operator is hired and when certification is complete.

Personnel not meeting these requirements may not scan participants without close supervision by a certified operator, unless specifically authorized by the Coordinating Center.

## 2.3 Review of HR-pQCT Scans

Scan quality will be ensured by a central review of all participant scans. Procedures for transferring scans to the Coordinating Center are outlined in Section 4.

### 2.3.1 Flagged Scans

Any scan that appears unusual should be flagged for review by the Coordinating Center. Guidelines for flagging scans are listed in Section 3.5.

Note the reason(s) for flagging on the MrOS Participant Scan Log and on the HR-pQCT exam form, for clarification of the problem.

The images will be reviewed for standard positioning and image quality. Instruction will be provided to the clinical centers for future exams.

## 3 HR-pQCT Exam Procedures

Standard scanning procedures for the distal tibia and distal radius are described in detail in the Scanco XtremeCT II Users' Manual. Some of the information from the Scanco manual is repeated in this manual for emphasis. Please note, however, that some of the scanning protocols for this study differ from those detailed by Scanco. In particular the MrOS protocol will collect a second, more proximal scan of the leg, in order to evaluate diaphyseal cortical bone and muscle.

The exam procedure described below includes several pre-scan tasks, including measuring the subjects forearm and tibial length, QC procedures, setup of the operator and patient in the scanner software, patient coaching, and patient positioning. The acquisition process involves pre-calibration of the source/detector unit, acquisition of a scout radiograph scan, and finally the tomographic acquisition. Finally data transfer and archiving procedures are performed following the subject scan. The following sections describe in detail the specific procedures to be conducted for the MrOS study.

Be sure to complete the participant's MrOS HR-pQCT transmittal form (teleform) (see Appendix A) during the course of the HR-pQCT exam.

NOTE: Followup scans require the transcription of select data from the baseline V4 teleform. The baseline teleform is required to provide the Scanco Patient Number, baseline limb length measurements, and to verify the correct laterality

## Overview of HR-pQCT Exam Workflow

1. Power on Scanner
2. Perform QC1 Daily and (if needed) QC2 Weekly
3. Perform evaluation of QC1 and QC2 scans
4. Verify QC values are in range
5. Perform forearm and tibial length measurements for subject\*\*
6. Explain exam procedure to subject
7. Prepare subject for tibia scans, place in cast
8. Pre-calibrate for tibial scans
9. Scout view for distal tibia
10. Scan for distal tibia
  - Repeat if motion detected
11. Scout view for proximal tibia
12. Scan for proximal tibia
  - Repeat if motion detected
13. Prepare subject for radius scans, place in cast
14. Pre-calibrate for radius scans
15. Scout view for distal radius
16. Scan for distal radius
  - Repeat if motion detected
17. Wait for Reconstructions to finish
18. Perform data transfer to MrOS Coordinating Center
  - QC1
  - All subject scans
19. Receive receipt confirmation from MrOS Coordinating Center
20. Archive RAW and IMA data to tape

\*\* *baseline exams only*

### 3.1 Scanner Power

For the XtremeCT II, Scanco recommends that the scanner be powered off when not in use for an extended period of time. This means that the scanner should be powered off most evenings following the final scan of the day. It is acceptable to leave the scanner powered on if scanning late in the afternoon and early on the following morning. In the more routine scenario where the scanner is powered down in the evening, the first thing the operator should do, prior to a subject exam, is to power on the scanner. This is done by simply turning the key switch located at the top left of the front panel of the XtremeCT. When powered on, the Power On LED on the front of the scanner will be illuminated green.

**NOTE:** Only the scanner should routinely be powered off and on. The workstation and peripheral devices should be left on.

**NOTE:** The XtremeCT II requires some minimal time to “boot” before the Scan software on the workstation can communicate with it. Please allow approximately 30s between flipping the key switch on the scanner, and starting the acquisition program.

### 3.2 Workstation Login

Once the scanner has been powered on you should login to the workstation. All tasks for MrOS should be performed using the standard MICORCT user account (username: microct).

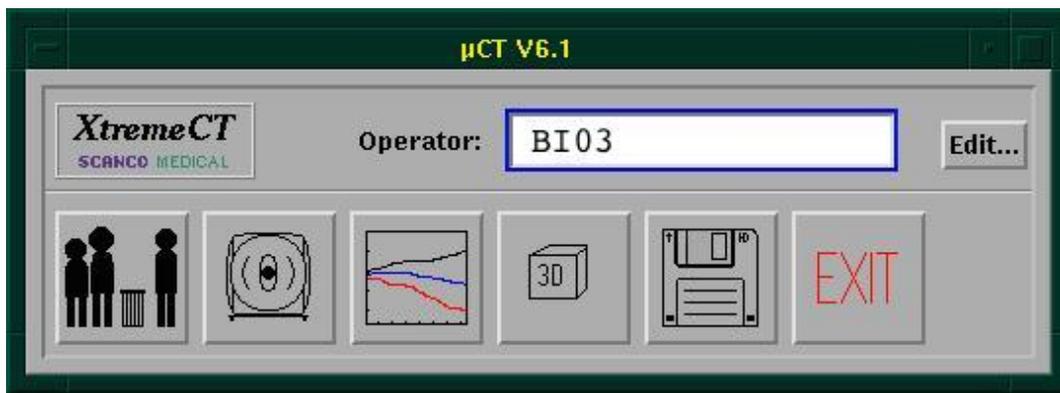
### 3.3 Operator

Prior to using any Scanco software an operator ID must be entered into the main  $\mu$ CT application dock. Please enter the MrOS staff ID code of the HR-pOCT operator performing the scans, and hit the <enter> key. The MrOS staff ID code consists of the four character staff ID issued for the MrOS study.

The following are the staff ID codes that will be used for the MrOS study:

Site	Operator Codes
Birmingham	BI01-BI99
Minneapolis	MN01-MN99
Palo Alto	PA01-PA99
Pittsburgh	PI01-PI99
Portland	PO01-PO99
San Diego	SD01-SD99

For the example in Figure 3-1, the operator at Birmingham has staff ID code BI03



**Figure 3-1:** MrOS Operator entry in  $\mu$ CT application dock.

**NOTE:** New operators must be registered in the scanner database. If the operator has not scanned previously, the Primary site operator should create an entry in the scanner registry using the corresponding operator code for the new operator. This is done using the “Edit...” button next to the Operator field in the main  $\mu$ CT panel, as seen in Figure 3-1.

### 3.4 QC scans

The standard QC phantom provided by Scanco (Figure 3-2) is used to perform bone density calibration by a Scanco engineer and for routine quality control procedures performed by the local operator.



**Figure 3-2:** Scanco XtremeCT II QC phantom

#### 3.4.1 QC1 (Daily)

It is recommended to perform the QC1 scan on a daily basis, regardless of whether a patient is to be scanned on a given day or not. At a very minimum, it is required that QC1 be performed every day for which a MrOS subject will be scanned, ideally first thing in the morning, prior to the first subject exam.

Follow the standard protocol described in the Scanco XtremeCT II manual for daily QC assessment:

- Confirm that the scanner gantry hitch is in the first position on the sliding rail
- Secure the QC Phantom in the scanner, with the cover closed

- Select the sample number corresponding to QC1 (Daily) scans (usually sample 1)
- Select the “QC1 (Daily)” controlfile
- Hit the “Pre-calibrate” button in the main window to run the pre-calibration process
- Hit the “Scan” button in the main window
- Hit the “Start Measurement” in the popup scan dialog box

### 3.4.2 QC2 (Weekly)

It is recommended to perform the QC2 scan on a weekly basis, regardless of whether a patient is to be scanned during a given week or not. At a very minimum, it is required that QC2 be performed every week for which a MrOS subject will be scanned, ideally on the first day of the week, prior to the first subject exam.

Follow the standard protocol described in the Scanco XtremeCT II manual for weekly QC assessment:

- Confirm that the scanner gantry hitch is in the first position on the sliding rail
- Secure the QC Phantom in the scanner, with the cover closed
- Select the sample number corresponding to QC1 (Daily) scans (usually sample 1)
- Select the “QC1 (Daily)” controlfile
- Hit the “Pre-calibrate” button in the main window to run the pre-calibration process
- Hit the “Scan” button in the main window
- Hit the “Start Measurement” in the popup scan dialog box

## 3.5 QC Analysis

Analysis of the QC scans should be performed so that the operator can verify the scanner is performing reliably prior to subject exams. Following acquisition of the daily QC1 and (when required) weekly QC2 scans the raw data is automatically reconstructed to create the image slices seen in the right panel of Figure 3-2. This typically takes less than 10 minutes. When the reconstruction process is complete the full image data can be opened in the evaluation program for analysis. By default QC1 and QC2 scans will be assigned their corresponding phantom analysis procedures in the evaluation tool, so the operator is simply left to open the scan and initiate the 3D Eval task:

### 3.5.1 QC1 (Daily)

Start the Evaluation program and follow the following procedure:

- Load the QC1 (Daily) scan that was just performed (under Patient/Sample number 1)
- Hit the “T...” button on the left of the Evaluation program to launch the tasks window
- The standard QC1 evaluation task is typically pre-loaded, so just click “Start Evaluation.”
  - If not, click “Select..” and choose the QC1 task from the list

- When the evaluation is complete you will either:
  - have an automatic result sheet printed to your local printer
  - have a PDF or PS electronic result sheet written to the measurement directory
- Review the values for deviations from your reference values ( $\pm 8 \text{ mg HA/cm}^3$ )
- If the values are outside the specification, you should first repeat the QC1 scan
  - If deviant values persist, contact Scanco, inform the Coordinating Center, and cancel the exam

### 3.5.2 QC2 (Weekly)

Start the Evaluation program and follow the following procedure:

- Load the QC2 (Weekly) scan that was just performed (usually under Patient/Sample number 2)
- Hit the “T...” button on the left of the Evaluation program to launch the tasks window
- The standard QC2 evaluation task is typically pre-loaded, so just click “Start Evaluation.”
  - If not, click “Select..” and choose the QC2 task from the list
- When the evaluation is complete you will either:
  - have an automatic result sheet printed to your local printer
  - have a PDF or PS electronic result sheet written to the measurement directory
- Review the values for deviations from your reference values ( $\pm 2\%$  from the reference volume)
- If the values are outside the specification, you should first repeat the QC2 scan
  - If deviant values persist, contact Scanco, inform the Coordinating Center, and cancel the exam

## 3.6 Laterality

By default the operator should scan the non-dominant forearm and leg, however there are certain scenarios where the contra-lateral limb should be scanned, or in some rare instances, where neither limb should be scanned.

**NOTE:** Followup scans should always be performed on the same side as the baseline scans. Confirm the laterality scanned at baseline for BOTH forearm and leg scans, from two sources:

- Baseline teleform
- The subjects measurement history which can be viewed in the measurement program

### 3.6.1 Determine dominance

The operator should ask the subject which side is their dominant arm, and separately, which is their dominant leg.

- Forearm dominance can be determined by asking which side they would swing a tennis racket with
- Leg dominance can be determined by asking which side they would kick a ball with
- Record the dominant hand and dominant foot in the MrOS HR-pQCT teleform

### 3.6.2 Scenarios for scanning the dominant

Under certain conditions, the operator should scan the dominant forearm:

- History of wrist/forearm fracture of the non-dominant forearm
- Non-removable hardware or jewelry in the scan region of the non-dominant forearm

Under certain conditions, the operator should scan the dominant leg:

- History of ankle/tibia fracture of the non-dominant leg
- Non-removable hardware or jewelry in the scan region of the non-dominant leg
- Complete non-weight bearing of the non-dominant leg for > 6 weeks in the previous 12 months. For example:
  - Joint replacement
  - Proximal limb fractures
  - ACL reconstruction

**NOTE:** Recent history of any of these procedures or conditions does not indicate the patient was subject to complete non-weight bearing for 6 weeks or more. The length and degree of reduced load bearing should be clearly determined.

**NOTE:** Reduced weight bearing (i.e. walking with a cane, a walker, or crutches with some load applied to both legs) does not constitute *complete non-weight bearing*. In these cases the non-dominant leg should be scanned.

### 3.6.3 Scenarios for not scanning either side

Under certain conditions, the operator should not scan either forearm:

- History of wrist/forearm fractures of both the dominant and non-dominant forearm
- Non-removable hardware or jewelry in the scan region of both the dominant and non-dominant forearm
- For followup scans, ***neither*** side should be scanned if the side scanned at baseline has sustained a wrist/forearm fracture or had non-removable hardware or jewelry introduced into the scan region since the time of the baseline visit

Under certain conditions, the operator should not scan either leg:

- History of ankle/tibia fractures of both the dominant and the non-dominant leg
- Non-removable hardware or jewelry in the scan region of the dominant and non-dominant leg
- Complete non-weight bearing of both the dominant and the non-dominant legs for > 6 weeks in the previous 12 months. For example:
  - Bilateral joint replacement
  - Bilateral proximal limb fractures
  - Bilateral ACL reconstruction

**NOTE:** Recent history of any of these procedures or conditions does not indicate the patient was subject to complete non-weight bearing for 6 weeks or more. The length and degree of reduced load bearing should be clearly determined.

**NOTE:** Reduced weight bearing (i.e. walking with a cane, a walker, or crutches with some load applied to both legs) does not constitute *complete non-weight bearing*. In these cases the non-dominant leg should be scanned.

- For followup scans, *neither* side should be scanned if the side scanned at baseline has sustained an ankle/tibia fracture, the side scanned at baseline has had non-removable hardware or jewelry introduced into the scan region since the time of the baseline visit, or if the subject has been subject to complete non-weight bearing of the baseline side for > 6 weeks in the previous 12 months.

### 3.7 Limb Length Measurements

Physical measurement of forearm length and lower leg length are required for the MrOS protocol. This data is being collected **at baseline only**, for subsequent research purposes (forearm length) and is required to define the proximal tibia scan location (lower leg length). It is important that the measurements be directly recorded in the MrOS HR-pQCT teleform **in units mm**.

**NOTE:** Followup scans ***must*** use the limb length measurements recorded at the baseline visits in order to insure the same region of interest is scanned at both time points. Please transcribe the length measures from the baseline teleform into the corresponding fields on the followup teleform, and use this tibial length value for the proximal tibia scan.

Material needed:

- A skin marker (for example a felt pen)

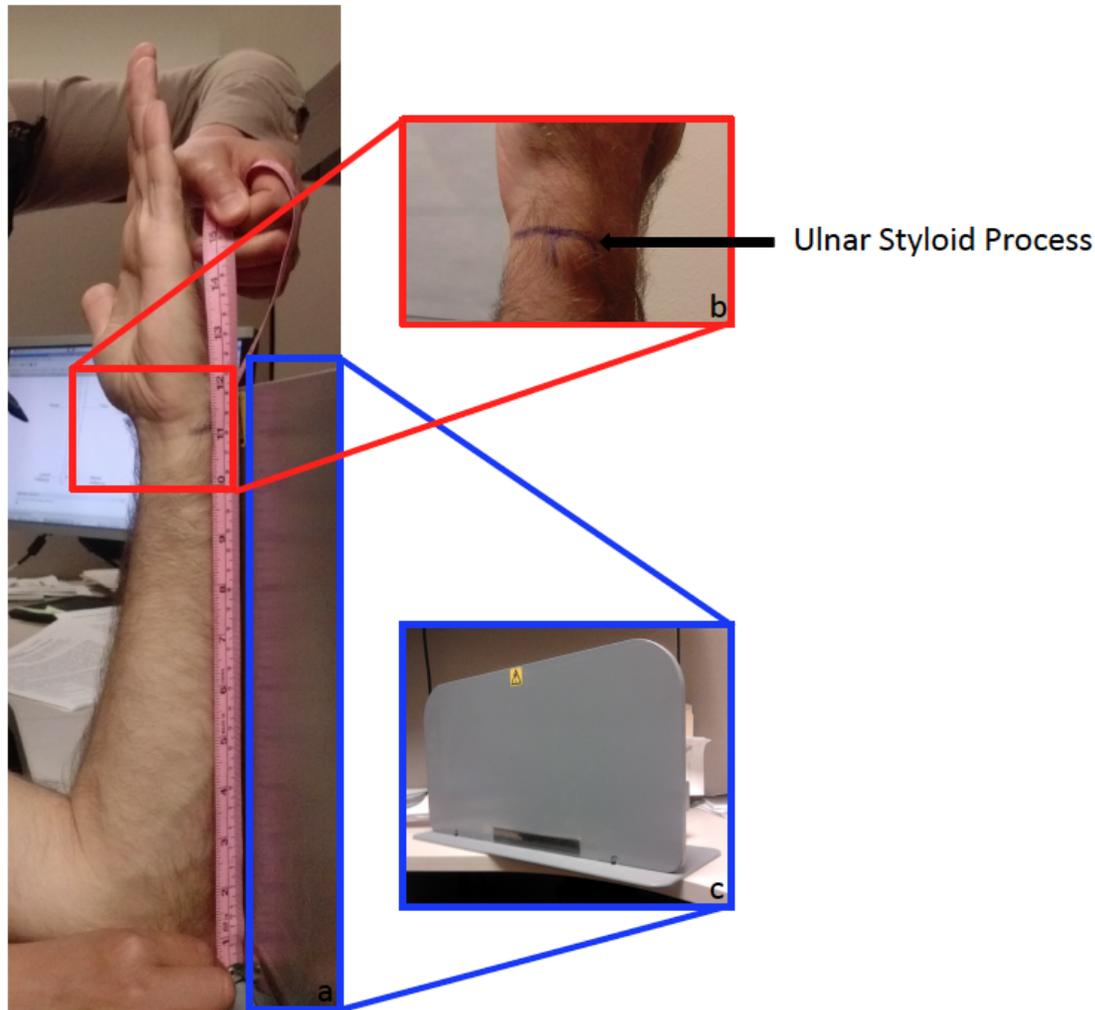
- A metric tape in millimeters
- A flat surface to rest the elbow on

### 3.7.1 Forearm Length

For the forearm, the length of the ulna is measured, which is easier to identify than the radius.

Steps for the measurement of ulna length:

- Position the elbow of the subject on a flat surface, with the forearm at 90 degree angle, with the fingers pointed straight up (Figure 3-3a)
- Identify and mark the ulnar styloid process, on the same side as the pinky finger (Figure 3-3b)
- Measure the vertical distance from the flat surface to the mark made over the styloid process (Figure 3-3a)
  - **NOTE:** The tape measure should be perpendicular to the flat surface where the elbow is resting, not curved along the surface of the forearm.
- Immediately record the length in **millimeters** on the MrOS HR-pQCT teleform



**Figure 3-3:** Measurement of the ulna length. a) Complete measurement setting. b) Identification of the ulnar styloid process. c) Flat surface used to measure the ulna length.

### 3.7.2 Tibial Length

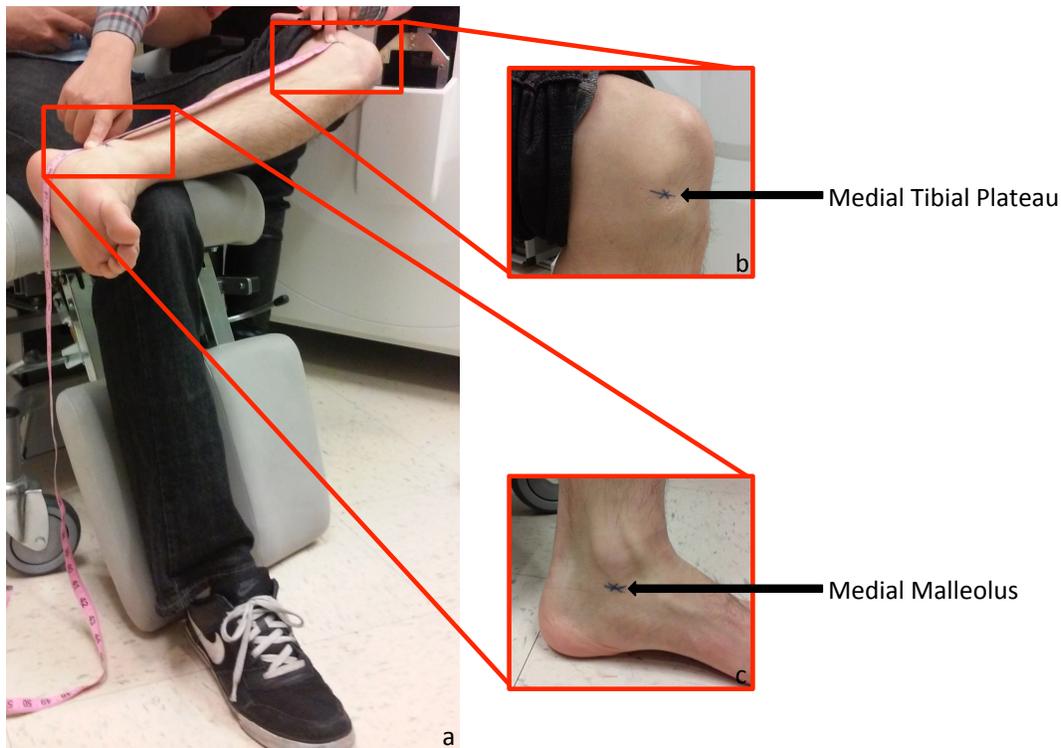
**NOTE:** Depending on the ability of the subject to bend his/her knee, variable methods for identifying the tibial plateau at the proximal end of the lower leg are proposed below. In general, we recommend operators to follow Method 1, described below, where the subject rests his/her ankle on the opposite knee. If the subject has difficulties with this position, the operator should follow Method 2; if the subject cannot bend his/her knee, operators should follow Method 3.

*Method 1: subject can bend his/her knee easily*

To measure tibia length:

- Ask the subject to sit his/her ankle to be scanned on the opposite knee (Figure 3-4a)

- Identify and mark with a “x” the medial tibial plateau (Figure 3-4b)
- Identify and mark with a “x” the distal edge of the medial malleolus (Figure 3-4c)
- Measure the length of the tibia from the medial tibial plateau to the distal edge of the medial malleolus (Figure 3-4a)
- Record the length in millimeters on the teleform and note the method used



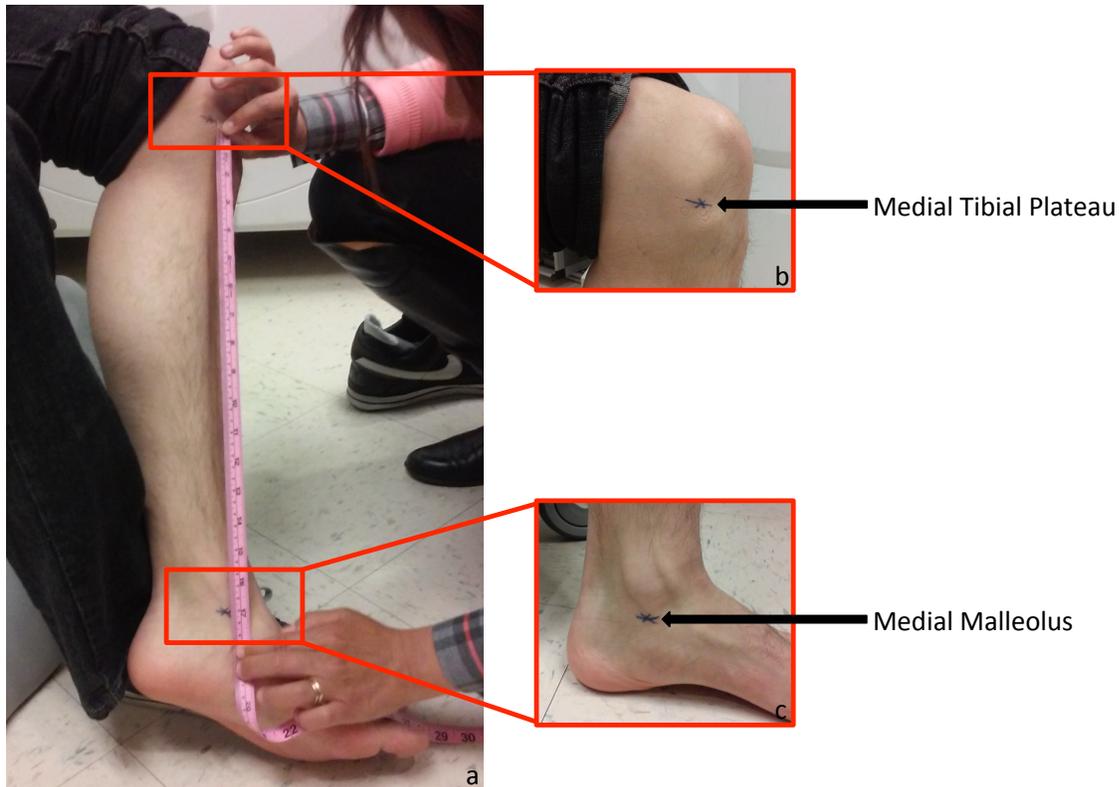
**Figure 3-4.** Measurement of the tibia length. a) Complete measurement setting. b) Identification of the medial tibial plateau. c) Identification of the medial malleolus.

*Method 2: subject has difficulties at bending his/her knee*

To measure tibia length:

- Ask the subject to sit his/her ankle to be scanned on the opposite ankle (Figure 3-5)
- Identify and mark with a “x” the medial tibial plateau (Figure 3-5b)
- Identify and mark with a “x” the distal edge of the medial malleolus (Figure 3-5c)
- Measure the length of the tibia from the medial tibial plateau to the distal edge of the medial malleolus (Figure 3-5a)

- Record the length in millimeters on the teleform and note the method used



**Figure 3-5.** Measurement of the tibia length. a) Complete measurement setting. b) Identification of the medial tibial plateau. c) Identification of the medial malleolus.

*Method 3: subject cannot bend his/her knee*

To measure tibia length:

1. Ask the subject to sit on a chair and slightly open his/her leg (Figure 3-6a)
2. Identify and mark with a “x” the medial tibial plateau (Figure 3-6b)
3. Identify and mark with a “x” the distal edge of the medial malleolus (Figure 3-6c)
4. Measure the length of the tibia from the medial tibial plateau to the distal edge of the medial malleolus (Figure 3-6)
5. Record the length in millimeters on the teleform and the method used

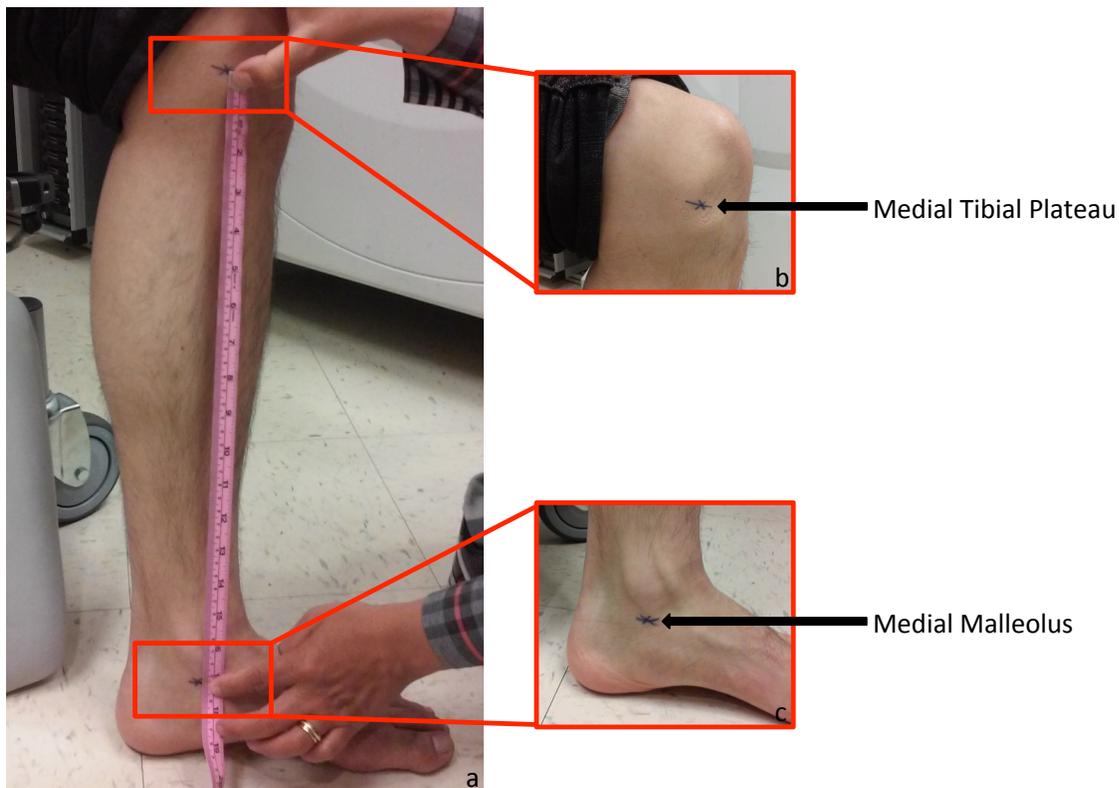


Figure 3-6. Measurement of the tibia length. a) Complete measurement setting. b) Identification of medial tibial plateau. c) Identification of the medial malleolus.

### 3.8 Patient Biography

For visit 4, a new entry in the Scanco database shall be created, **at baseline only**, for each subject using the  $\mu$ CT Samples application. The simplest way to start the patient biography entry process is from the tomography software itself. Click on the “New” button in the patient data panel, which will launch the Samples window seen in in Figure 3-7

An example of the PATIENT BIOGRAPHY screen for a participant with last name 'SMITH' at Birmingham is shown in Figure 3-7.

**NOTE:** For followup visits, you must not create a new database entry. Instead you will scan the subject under their original database ID. Refer to their baseline teleform and locate the Patient Number field. To collect followup scans, select the subjects existing ID in the tomography program by clicking the “Other...” button in the patient data panel, then enter the Patient Number created during the baseline visit in the small window that pops up. Proceed to section 3.9 to continue with the followup exam protocol.

The screenshot shows a software window titled "SCANCO μCT-Samples V1.1". Inside the window, there is a "File" menu bar. Below it, several input fields are visible: "Sample Number:" with a small text box; "Name:" with a larger text box containing the text "BI1301JSMI"; "Date of Birth:" with a date picker; "Remarks:" with a large text area; "Modified:" with a date picker; and "1. Measurement:" with a small text box. At the bottom of the window, there are four buttons: "Find...", "Find Next", "New", and "Save".

**Figure 3-7:** Patient Biography entry in  $\mu$ CT Samples Application

### 3.8.1 Name Field

The name field will be completed with a combination of the subject's enrollment ID and patient acrostics.

The enrollment ID consists of a 6-character combination of the clinic letter code and the participant number. It is the single most important piece of information associated with each participant and must be entered precisely. Consider the sample participant discussed above. Suppose the clinic ID is BI (Birmingham) and the participant number is 1301, then Figure 1 demonstrates the correct method for entering the study ID within the Patient ID field.

Acrostics consist of the first letter of the first name and the first three letters of the last name. e.g. The acrostic for James Smith would be JSMI.

The following are the clinic letter codes and participant numbers that will be used for the MrOS study:

Site	Participant Codes
Birmingham	BI0001-BI1500
Minneapolis	MN1501-MN3000
Palo Alto	PA3001-PA4500
Pittsburgh	PI4501-PI6500
Portland	PO6501-PO8000
San Diego	SD8001-SD9500

**When entering data into the Patient Biography fields, please be sure to:**

- Use zero (0), not the letter 'O', for numerical data.

- Use all capital letters.
- Enter the enrollment ID followed by the participant acrostic as a single continuous string with no extraneous spaces.

### 3.8.2 Date of Birth Field

The DOB field will not be used in the MrOS Study and should be left blank.

### 3.8.3 Remarks Field

The remarks field in the patient biography window will not be used and should be left blank.

When the biographical information has been completely entered, click on the “Save” button at the bottom right of the  $\mu$ CT Samples application window. This will generate the new database entry for this patient that will be used for all subsequent scans for this subject. When the entry has been create successfully the Scanco database ID will be indicated in the un-editable “Sample Number” field and a creation/modification timestamp will be reported in the “Modified” Field, as seen in Figure 3-8. **Record the Patient Number on the MrOS HR-pQCT teleform.**

**IMPORTANT:** The “Sample Number” is interchangeably referred to as the “Patient Number” and is the primary key that identifies each individual participant across the XtremeCT databases.

The screenshot shows a software window titled "SCANCO  $\mu$ CT-Samples V1.1". Inside the window, there is a "File" menu bar. Below it, several fields are visible: "Sample Number:" with the value "2715", "Name:" with the value "BI1301JSMI", "Date of Birth:" which is empty, "Remarks:" which is empty, "Modified:" with the value "5-FEB-2014 16:46:08.49", and "1. Measurement:" which is empty. At the bottom of the window, there are four buttons: "Find...", "Find Next", "New", and "Save".

**Figure 3-8:** Patient Biography entry in  $\mu$ CT Samples Application after it is saved

To make this subject active, select *File > Exit* in the Samples window to return to the acquisition software. Scans for the new subject can now be performed.

### 3.9 Patient Coaching

The high resolution of the XtremeCT II makes it particularly sensitive to image degradation due to patient motion. Communication with the participant is critical for maximizing the likelihood that you will obtain high quality image data and reducing the incidence of motion artifacts. In addition to careful patient immobilization and positioning, allowing two minutes to focus exclusively on explaining the steps of the procedure to the patient, and ensuring that they understand how to minimize movement is important.

Communicate to the patient:

- There will be three scans, each taking approximately 2 minutes. Two in the lower leg, one in the forearm.
- It is possible any of the scans will need to be repeated if there is motion, but not more than twice.
- It is relatively common to repeat, and you may not have perceived any movement at all during the scan (this is mainly to provide them some reassurance – some patients may become upset if they believe they did something wrong)
- Inform the patient that you will tell them when each scan is about to start, and will let them know when each scan is completed
- They should not talk during the scan
- Between scans they are allowed to reposition for comfort, scratch an itch, have a drink of water (especially important if they are having a cough), etc.
- It is important they understand the scanner will make noise on and off during the acquisition (i.e. for the scout scan, then quiet while the reference line is positioned, then noise again during the tomographic acquisition) and that they should maintain their position and be still throughout. (You will tell them the scan is starting *before* starting the scout view)
- They should be instructed to take regular, even breathes. They should be asked, if possible, to not inhale or exhale deeply, and not to hold their breath.
- They should find a comfortable position for the arms and legs which are not in the scanner, and they should not change position of these during the scan
- Similarly they should find a comfortable position for their head and maintain this during the scan (a pillow behind the head/neck/shoulders is recommended)

For the Operator:

- Ensure no jewelry or extra clothing is located in the scan field of view

- Preferably, have the subject change into a hospital gown if they have bulky clothes
- If a proxy or translator is required and will be in the room during the exam, they should also be instructed not to talk, move, or make noise during the scan.
- Any persons in addition to the operator and subject that will remain in the room should be directed to sit or stand in a position away from the front of the scanner.
- Operators should take appropriate actions to ensure that third parties do not enter the scan room during the exam, especially in the middle of a scan as this can cause the subject to move. This may include signage on the door, illuminating XRAY-On lamps if available, and coordinating with local staff to control room access.

### 3.10 Scanning

Subject scans will be performed at the distal radius and tibia. At UCSF we typically start with the tibia scan as motion occurs less frequently for this site, and therefore allows the patient to become accustomed to the scan procedure before moving to the radius, which is more prone to motion. In the event of significant motion, two repeat measurements are allowed at each site for the baseline (so 3 scans in total are possible for each site, if necessary).

**NOTE:** Operators should have performed the scan positioning training exercises and passed with acceptable the test for precision prior to scanning subjects. It is also recommended to repeat the training/evaluation exercise on a semi-annual basis.

#### 3.10.1 Distal Tibia scan setup

The initial step is place the subject's leg in the cast:

- For MrOS it is suggested to use the “large” foot pad with the leg cast to minimize the thickness underfoot, which makes it difficult to acquire the proximal tibia scan

With the patient situated in the chair and cast, return to the computer to proceed with the scan setup:

- Verify the correct Patient/Sample Number is set in the patient data panel
  - If not, press the “Other” button and specify the appropriate Patient Number/Sample Number from the Scanco database that corresponds to the subject to be scanned. This should have been recorded to the MrOS HR-pQCT exam teleform in the previous step. Verify corresponding Patient ID corresponds to the details on the MrOS HR-pQCT teleform.
  - Confirm that the Patient/Sample Number selected in the patient data panel corresponds to the Patient Number from the baseline teleform
- Enter “V4” for Visit 4 in the “Measurement Remarks” field

- For V4 followup scans, enter “V4.5” in the “Measurement Remarks” field
- Select the Standard Tibia controlfile corresponding to the correct Right/Left laterality.
  - Verify site AND laterality of the controlfile correspond to the site the patient has been prepared for and is consistent with what was recorded on the MrOS HR-pQCT teleform.
  - For followup scans, verify that the site AND laterality of the controlfile correspond to the site and laterality of the baseline scans listed under “Measurement History” AND the site/laterality listed on the baseline teleform
- Perform the Pre-calibration with the subject away from the scanner.
- Move the scanner gantry hitch to the third position on the sliding rail
- Position the subject in the scanner, ensuring that the cast is securely resting on the gantry supports

### 3.10.2 Distal Tibia scout acquisition

It is important to acquire a Scout image that covers a sufficient region distal and proximal to the scan region. The scout images will subsequently be used to retrospectively evaluate scan position quality. For the tibia the scout scan should cover the entire distal end of the tibia, the complete tibial-talar joints in the distal direction, and several cm into the diaphyseal zone in the proximal direction (Figure 3-9).

- With the patient positioned for scan and ready, push the “Scout View” button in the main tomography window
- Do not change any of the default Scout start/end and angle settings, simply start the Scout scan
  - **NOTE:** IF the scout image acquired with the default positions does not cover the entire distal end of the radius/tibia OR does not cover enough proximally to set the reference line (see Figure 3-5), adjust the scout start and end positions appropriately.



**Figure 3-9:** Acceptable (left) and unacceptable (middle, right) scout scans. In fact an ideal scan will start 5mm distal to (above) the tibial malleolous, and extend 80mm in the proximal direction.

- Review the coverage of the tibia in the initial scout scan. The scout image should begin approximately 5mm distal (above the tip of the tibial malleolous, and extend a total of 80mm
- If the scout coverage is not sufficient, adjust as follows:
  - Use the reference line tool and the position feedback it provides to help you guess an appropriate start position so that the scout starts 5mm above the tip of the tibial malleolous.
  - Adjust the start position in the scout view window according to this estimate
  - Adjust the end position to be 80 mm greater
  - Repeat the scout view acquisition
  - Review coverage of the new scout, as above, and repeat again if needed to arrive at a satisfactory scout view.
- For baseline scans, set the reference line position in the Scout View window according to the training provided by the UCSF scan positioning training tool.
- For followup scans, set the reference line position in the Scout View window to match precisely the position set for the baseline scan, which is displayed in the bottom right corner of the tomography program.
  - **NOTE:** this may not correspond exactly with the position you would choose based on the training guidelines. For followup scans it is more important that the positions are consistent compared to baseline, rather than that they match exactly with the recommended position.

### 3.10.3 Distal Tibia tomographic acquisition

With the Scout View acquisition, reference line positioned, the tomographic acquisition can be performed:

- Click “OK” in the main Scout View dialog window
- Click “Scan...” in the main program window and click through to start the measurement
- Record the measurement number in the MrOS HR-pQCT form
- Upon completion of the scan, check the image quality in the low-res preview reconstruction (refer to separate image quality grading document).
  - Record the image quality grade in the teleform
  - If image quality grade 1 or 2, move on to the next measurement site
  - If image quality grade 3 or worse, repeat up to two times for each site

**NOTE:** If repeating for image quality purposes you must repeat the entire steps starting with the Scout acquisition section.

**NOTE:** You should not need to repeat the pre-calibration step, unless it has expired. If that is the case you must remove the subject from the scanner and pre-calibrate before proceeding with the repeat scan.

### 3.10.4 Proximal tibia scan setup

If the pre-calibration has not expired, it may be possible to proceed immediately with the proximal tibia scan. However it is first necessary to move the patient further into the scanner bore, using the special purpose extension hitches that were designed to allow the standard cast to scan the proximal site:

- Move the patient into the scanner, using the rear, proximal extension hitches on the cast.

With the patient situated in the chair and cast, return to the computer to proceed with the scan setup. All scans sites will be performed under a single Patient Number in the database. Therefore the Patient Number/Sample Number entered for the Distal Tibia will also be used for the Proximal Tibia scan.

- Verify the correct Patient/Sample Number is set in the patient data panel
  - If not, press the “Other” button and specify the appropriate Patient Number/Sample Number from the Scanco database that corresponds to the subject to be scanned. This should have been recorded to the MrOS HR-pQCT exam form previous step. Verify corresponding Patient ID corresponds to the details on the MrOS HR-pQCT teleform.
  - Confirm that the Patient/Sample Number selected in the patient data panel corresponds to the Patient Number from the baseline teleform
- Confirm that “V4” for Visit 4 is entered in the “Measurement Remarks” field
  - For V4 followup scans, enter “V4.5” in the “Measurement Remarks” field
- Select the Proximal Tibia controlfile corresponding to the correct Right/Left laterality.
  - Verify site AND laterality of the controlfile correspond to the site the patient has been prepared for and is consistent with what was recorded on the MrOS HR-pQCT teleform.
  - For followup scans, verify that the site AND laterality of the controlfile correspond to the site and laterality of the baseline scans listed under “Measurement History” AND the site/laterality listed on the baseline teleform
- Perform the Pre-calibration with the subject away from the scanner.
- Confirm that the scanner gantry hitch is in the third position on the sliding rail

**NOTE:** If the pre-calibration has expired, you will first need to remove the subject from the scanner, perform the pre-calibration again, then position them back in for the proximal scan.

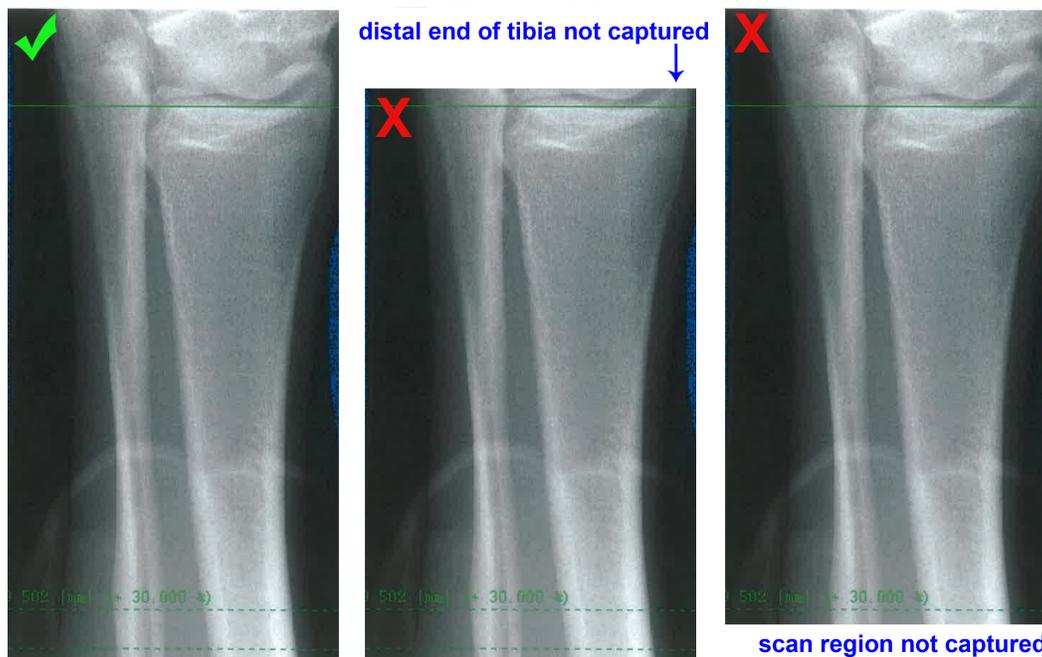
### 3.10.5 Proximal tibia scout acquisition

It is important to acquire a Scout image that covers a sufficient region distal and proximal to the scan region. The proximal scan is particularly tricky because you must capture both the tibial

plafond to place your reference line, and the proximal scan region, which is 100-150mm in the proximal direction.

- With the patient positioned for scan and ready, push the “Scout View” button in the main tomography window
- Enter the tibial length **in mm**, measured at the beginning of the exam. Confirm the entry against the length recorded in the teleform.
  - **NOTE:** For followup scans, the tibial length entered should be the measured length recorded at the baseline visit. Confirm that the value entered is identical on the baseline and followup teleform
- Do not change any of the default Scout start/end and angle settings, simply start the Scout scan
  - **NOTE:** If the scout image acquired with the default positions does not cover the entire distal end of the radius OR does not cover enough proximally to set the reference line (see Figure 3-10), adjust the scout start and end positions appropriately.
- Review the coverage of the tibia in the initial scout scan. The scout image should begin approximately 5mm distal to (above) the tip of the tibial malleolous, and extend to the full 200mm position

**NOTE:** The scan range lies between two dotted lines towards the bottom of the scout. Both dotted lines must be visible, and the scan range must not overlap with any metal parts of the cast, as seen in the scout view. If this is the case you should remove the subject from the scanner and remove the foot pad from the cast, then reposition and repeat the scout process.



**Figure 3-10:** Acceptable (left) and unacceptable (middle, right) scout scans. In fact, an ideal scan will start 5mm distal to (above) the tibial malleolous, and extend maximally in the proximal direction. Note that a scout scan properly expanded to the full 200mm position will be lower contrast throughout, with a high intensity artifact at the bottom resulting from the metal cast.

- If the scout coverage is not sufficient, adjust as follows:
    - Use the reference line tool and the position feedback it provides to help you guess an appropriate start position so that the scout starts 5mm above the tip of the tibial malleolous.
    - Adjust the start position in the scout view window according to this estimate
    - The end position should remain at 200mm
    - Repeat the scout view acquisition
    - Review coverage of the new scout, as above, and repeat again if needed to arrive at a satisfactory scout view.
- NOTE:** For subjects with extremely long legs, it may be difficult or even impossible to set the reference line for the proximal location. If the reference line can not be placed on the standard landmark because the leg is too large:
1. Remove the foot pad from the cast and reposition the subject, ensuring their heel is all the way against the bottom of the cast.
  2. If the scan site is still out of range, skip the proximal scan and record the reason in the teleform.
- For baseline scans, set the reference line position in the Scout View window according to the training provided by the UCSF scan positioning training tool.
  - For followup scans, set the reference line position in the Scout View window to match precisely the position set for the baseline scan, which is displayed in the bottom right corner of the tomography program.
    - **NOTE:** this may not correspond exactly with the position you would choose based on the training guidelines. For followup scans it is more important that the positions are consistent compared to baseline, rather than that they match exactly with the recommended position.

### 3.10.6 Proximal tibia tomographic acquisition

With the Scout View acquisition, reference line positioned, the tomographic acquisition can be performed:

- Click “OK” in the main Scout View dialog window
- Click “Scan...” in the main program window and click through to start the measurement
- Record the measurement number in the MrOS HR-pQCT teleform
- Upon completion of the scan, check the image quality in the low-res preview reconstruction (refer to separate image quality grading document).
  - Record the image quality grade in the teleform
  - If image quality grade 1 or 2, move on to the next measurement site
  - If image quality grade 3 or worse, repeat up to two times for each site
  - **NOTE:** If repeating for image quality purposes you must repeat all steps, beginning with the Scout acquisition section.

### 3.10.7 Distal Radius scan setup

The initial step is place the subjects forearm in the cast:

- Select the appropriate laterality for the arm to be scanned

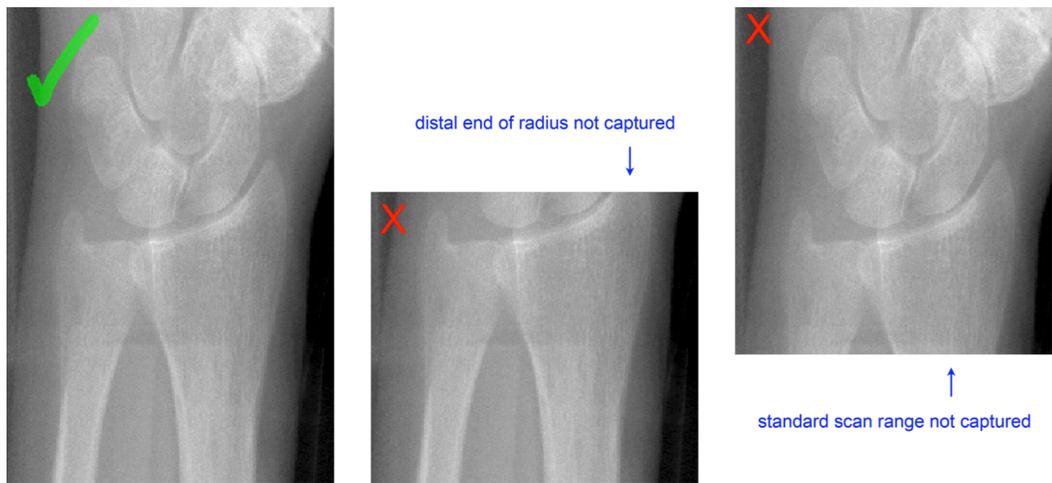
With the patient situated in the chair and cast, return to the computer to proceed with the scan setup. All scans sites will be performed under a single Patient Number in the database. Therefore the Patient Number/Sample Number entered for the Distal Tibia will also be used for the Distal Radius scan.

- Verify the correct Patient/Sample Number is set in the patient data panel
  - If not, press the “Other” button and specify the appropriate Patient Number/Sample Number from the Scanco database that corresponds to the subject to be scanned. This should have been recorded to the MrOS HR-pQCT exam form previous step. Verify corresponding Patient ID corresponds to the details on the MrOS HR-pQCT teleform.
  - Confirm that the Patient/Sample Number selected in the patient data panel corresponds to the Patient Number from the baseline teleform
- Confirm that “V4” for Visit 4 is entered in the “Measurement Remarks” field
  - For V4 followup scans, enter “V4.5” in the “Measurement Remarks” field
- Select the Standard Radius controlfile corresponding to the correct Right/Left laterality.
  - Verify site AND laterality of the controlfile correspond to the site the patient has been prepared for and is consistent with what was recorded on the MrOS HR-pQCT teleform.
  - For followup scans, verify that the site AND laterality of the controlfile correspond to the site and laterality of the baseline scans listed under “Measurement History” AND the site/laterality listed on the baseline teleform
- Perform the Pre-calibration with the subject away from the scanner.
- Confirm that the scanner gantry hitch is in the third position on the sliding rail
- Position the subject in the scanner, ensuring that the cast is securely resting on the gantry supports

**NOTE:** Use the rear pair of hitches on the forearm cast for positioning in the scanner. This is the set that is located closest to the elbow.

### 3.10.8 Distal Radius scout acquisition

It is important to acquire a Scout image that covers a sufficient region distal and proximal to the scan region. The scout images will subsequently be used to retrospectively evaluate scan position quality. For the radius the scout scan should cover the entire distal end of the radius, including the radiocarpal joints in the distal direction, and several cm into the diaphyseal zone in the proximal direction (Figure 3-10).



**Figure 3-10:** Acceptable (left) and unacceptable (middle, right) scout scans. In fact an ideal scan will 10 mm distal (above) the end of the radius, and span 70mm in total.

- With the patient positioned for scan and ready, push the “Scout View” button in the main tomography window
- Do not change any of the default Scout start/end and angle settings, simply start the Scout scan
  - NOTE:** IF the scout image acquired with the default positions does not cover the entire distal end of the radius OR does not cover enough proximally to set the reference line (see Figure 3-10), adjust the scout start and end positions appropriately.
- Review the coverage of the radius in the initial scout scan. The scout image should begin approximately 10mm distal (above the distal tip of the radius, and extend a total of 80mm
- If the scout coverage is not sufficient, adjust as follows:
  - Use the reference line tool and the position feedback it provides to help you guess an appropriate start position so that the scout starts 10mm above the tip of the radius
  - Adjust the start position in the scout view window according to this estimate
  - Adjust the end position to be 80 mm greater
  - Repeat the scout view acquisition
  - Review coverage of the new scout, as above, and repeat again if needed to arrive at a satisfactory scout view.
- For baseline scans, set the reference line position in the Scout View window according to the training provided by the UCSF scan positioning training tool.
- For followup scans, set the reference line position in the Scout View window to match precisely the position set for the baseline scan, which is displayed in the bottom right corner of the tomography program.
  - **NOTE:** this may not correspond exactly with the position you would choose based on the training guidelines. For followup scans it is more important that the positions are consistent compared to baseline, rather than that they match exactly with the recommended position.

### 3.10.9 Distal Radius tomographic acquisition

With the Scout View acquisition, reference line positioned, the tomographic acquisition can be performed:

- Click “OK” in the main Scout View dialog window
- Click “Scan...” in the main program window and click through to start the measurement
- Record the measurement number in the MrOS HR-pQCT form
- Upon completion of the scan, check the image quality in the low-res preview reconstruction (refer to separate image quality grading document).
  - Record the image quality grade in the teleform
  - If image quality grade 1 or 2, move on to the next measurement site
  - If image quality grade 3 or worse, repeat up to two times for each site

**NOTE:** If repeating for image quality purposes you must repeat the entire steps starting with the Scout acquisition section.

**NOTE:** You should not need to repeat the pre-calibration step, unless it has expired. If that is the case you must remove the subject from the scanner and pre-calibrate before proceeding with the repeat scan.

## 4 Data Management

The clinical center is responsible for maintaining soft copies of the RAW data for all phantom and subject scans performed during the study. Both the RAW and reconstructed (IMA) data will be transferred to the Coordinating Center via Internet on a routine basis. After successful transfer of data has been verified by UCSF, the appropriate local backup procedures should be followed to archive data locally.

### 4.1 Internet transfer to UCSF Coordinating Center

In this section, the RAW and IMA data will be sent to the Coordinating Center via network.

**NOTE:** Data transfers should be initiated not more than 24hrs following an exam.

**NOTE:** For every day that one or more subjects are scanned, a corresponding QC1 Daily phantom scan should be transferred to the Coordinating Center, in addition to the subject scans.

**NOTE:** Only transfer measurements that have finished reconstructing! Verify in the **evaluation program** that all slices have been reconstructed or check the batch queues (use the “que” command in a DECterm window to see if any remaining “UCT\_RECONSTRUCTION” jobs are executing or pending).

If ready to transfer, you will now open each measurement in the evaluation program and initiate their transfer:

- Start the Evaluation application by clicking the third icon from the left in the main  $\mu$ CT application dock (see Figure 3.1; the icon appears like a line graph)
- Load the measurement of interest in the Select Measurement pop-up window (Figure 4-1)

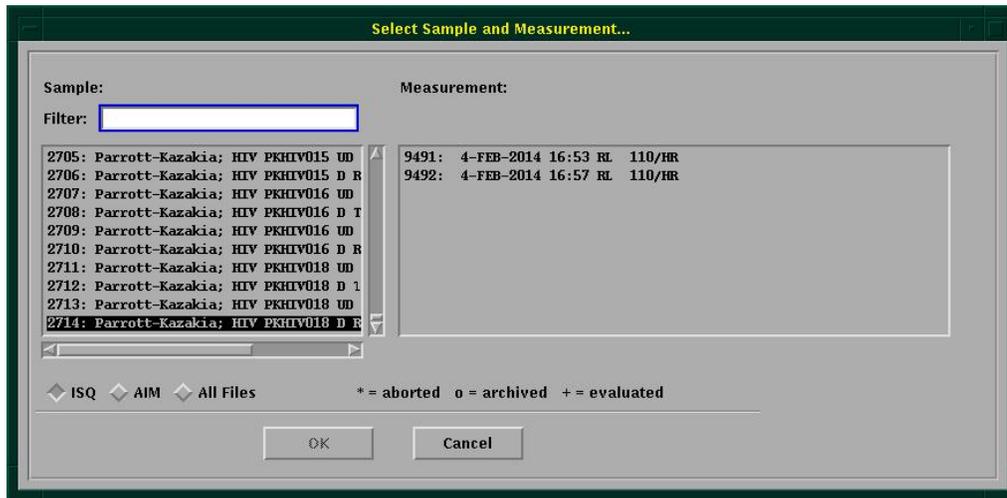


Figure 4-1: Select Measurement For Transfer

- **Important:** Verify that all slices load in the preview panel, indicating that the reconstructions have finished. If the reconstructions are still in process, an error measure will indicate a Read Failure OR some tiles in the right 4x4 preview pane will be empty. Otherwise you will see images in all 16 (4x4) preview panes, as illustrated in Figure 4-2.

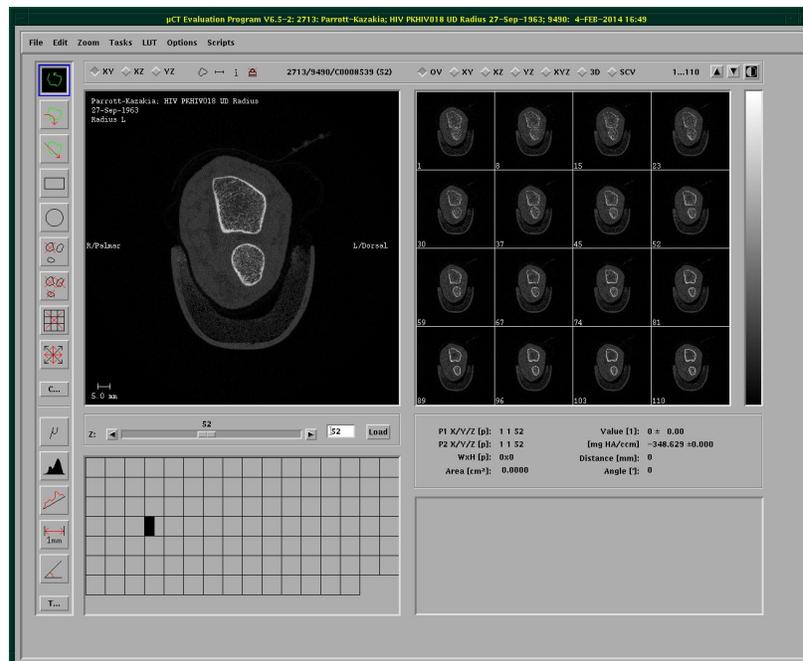
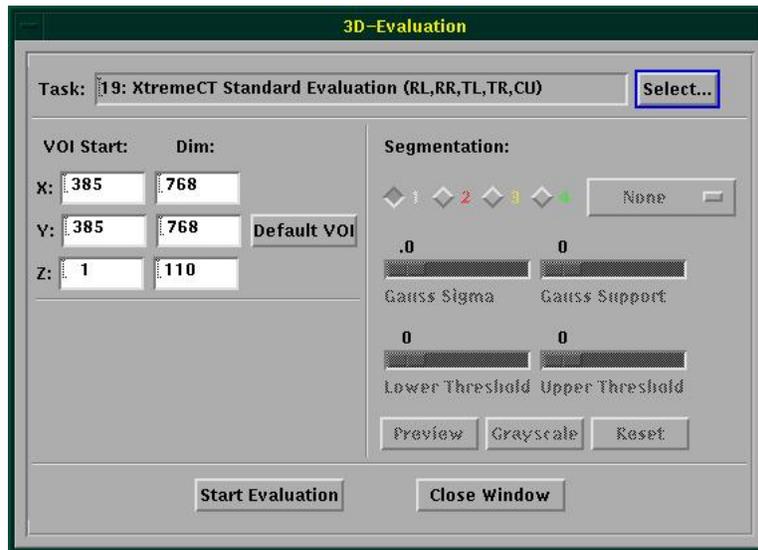


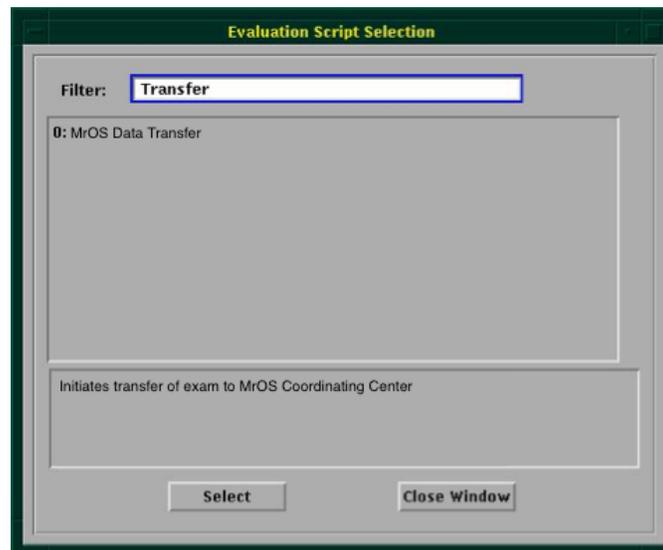
Figure 4-2: 3D Evaluation Program

- With the measurement loaded in the Evaluation application, browse to “Tasks> Evaluation 3D...”, which opens the 3D Evaluation dialog (See Figure 4-3)



**Figure 4-3:** 3D Evaluation Dialog

- Click the Select button and find the task “MrOS Data Transfer”, which should be installed (see Figure 4-4)



**Figure 4-4:** Evaluation Script Selection for Data Transfer to Coordinating Center

- Disregard all VOI, Segmentation, and other parameters in the 3D Evaluation dialog
- Click “Start Evaluation” button in the 3D Evaluation dialog
- Review the output of the “que” command in a DECterm window, to verify the transfer task is running or pending:

```

$ que

QUEUE: SC3412_BATCH
 197 SUBMIT_SHUTTER_TEST
1 job in SC3412_BATCH

QUEUE: SC3412_FAST
 198 EVAL_MROS_TRNSFR
1 job in SC3412_FAST
Total number of jobs: 2
$

```

- Repeat these steps for each scan to be transferred

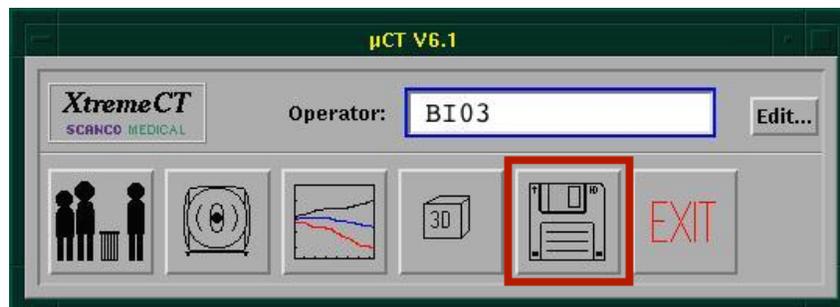
## 4.2 Tape transfer to UCSF Coordinating Center

This procedure serves as an **alternative** to that outlined in Section 4.1, intended for sites with insufficient bandwidth for timely network transfers or as an interim solution during extended server downtimes. In this section, the RAW and IMA data will be copied to an external tape for transfer to the Coordinating Center via courier service.

**NOTE:** The following should be performed AT THE END OF THE DAY when no scans remain to be acquired. This procedure should only be run AFTER all batch jobs (especially RECON) are finished running in the queue. To confirm, type the “que” command in the DECterm window to view jobs on the batch queues.

**NOTE:** It is NOT OKAY to run this procedure or have this procedure running in the background during a participant scan.

- Start the backup program by clicking the tape icon in the main  $\mu$ CT application dock



**Figure 4-5:**  $\mu$ CT application dock, backup program icon highlighted in red

- Load a new tape (not previously initialized) that will be the dedicated tape for transfers to the CC. Note that if you have already transferred data to the CC by tape, use the previous tape and skip to mounting the tape.
- Click the “Initialize...” button. Click “Yes” in the followup “Please Confirm” dialog box.

- For the requested label in the “Initialize” dialog box, enter your MrOS site ID code, followed by “2SF”, then followed by a single digit serial (1,2,3...). For example, Birmingham’s first transfer tape should be labeled BI2SF1. The tape drive will whir then quiet when the initialization is complete.
- Click the “Mount” button. Again, the tape drive will whir then quiet.
- Select all QC1 and MrOS participant measurements for which you would like to transfer data. You may drag select or shift-click to select a range of measurements, and ctrl-click to add individual measurements to the selection. The selected measurements will be highlighted in black.
- You will first copy the RAW data to tape. Under “Selected Measurement”, select the RAW radio button option.
- In the drop down menu below and to the right, select/verify “Copy To” as the mode (NOT “Move To”!!).
- To the right of that, select/verify destination is the tape icon.
- After double-checking that the previous steps have been properly followed, click the “Start” button to the right. Confirm that you want to copy the RAW data for selected measurements to tape to begin. A popup dialog box will indicate the progress of the copy operation. The backup may take some time, depending on the amount of exams.



**Figure 4-6:** Backup program window, highlighted in red locations of (A) RAW/IMA radio buttons (B) Move-To / Copy-To dropdown menu (C) destination dropdown menu (D) Mount button (E) Dismount button (F) Initialize button

- The tape drive will make regular noises as the copying proceeds. When the copying has completed, the progress dialog box will disappear and the normal arrow cursor will again be available for interaction with the backup program.
- To then copy the IMA data for the same measurements to tape, select the IMA radio button option. If the previous steps were just completed, the measurements selected for RAW data copying will already be selected still.
- Verify that the “Copy To” and tape destination options are again selected. Then, click the “Start” button and confirm that you want to copy the IMA data to tape.
- Once both the RAW and IMA data have finished copying to tape, eject the tape by clicking the “Dismount” button. Once ejected, adhere a written label (e.g. BI2SF1) to appropriate region of the tape.
- Mail the tape by an appropriate courier service to the Coordinating Center:

Andrew Yu  
University of California, San Francisco  
Department of Epidemiology and Biostatistics  
Mission Hall: Global Health & Clinical Sciences Building  
550 16th Street, 2nd floor, Box #0560  
San Francisco, CA 94158-2549

- Notify Andrew Y ([andrew.yu@ucsf.edu](mailto:andrew.yu@ucsf.edu)) with an expected arrival date for each shipment.

### 4.3 Local Archive

In this section, the RAW and IMA data will be archived to a local tape drive. The steps are similar to those described in Section 4.2, except data will be **moved** off the workstation disk onto external tapes.

**NOTE:** Local archiving should be performed once transfer to the Coordinating Center has been verified.

**NOTE:** It is highly recommended that separate tapes be used to backup RAW and IMA data

#### 4.3.1 Archive of RAW data

RAW data should be archived first, as soon as the transfer to the Coordinating Center has been verified. There is no other practical use for the RAW data at the clinical center, once the images have been reconstructed, so these should be archived to maintain adequate free space on disk for new scans.

- Start the Scanco Backup software from the  $\mu$ CT main application dock.
- Insert and mount the appropriate RAW archiving tape.

- Select the measurements on disk to be archived.
- Select the “RAW” radio button option.
- Select the “Move To” and “Tape” options.
- Click the start button and confirm.
- When finished, dismount the tape and return to storage.

#### **4.3.2 Archive of IMA data**

IMA data, which includes the full field reconstructed images (ISQ files), VOI contours (GOBJ files), derivative image files (AIM files), and other miscellaneous derivative files should be archived if no longer needed by the clinical site. If a local analysis or other local use is planned for the data by local investigators, it may be kept online for an extended period of time at their discretion. However if no longer needed, the IMA data should be archived to tape to maintain adequate free space on disk for new scans.

- Start the Scanco Backup software from the  $\mu$ CT main application dock.
- Insert and mount the appropriate IMA archiving tape.
- Select the measurements on disk to be archived.
- Select the “IMA” radio button option and “\*” all files option.
- Select the “Move To” and “Tape” options.
- Click the start button and confirm.
- When finished, dismount the tape and return to storage.

# Appendix A

The MrOS HR-pQCT teleform for recording subject exam information. The form is available on the SF Coordinating Center MrOS website under Documents & Forms > Forms > Visit 4 Forms > Clinic Exam Forms > Pages 25-26, HRpQCT

An example of this form is shown here.

**HRpQCT** 33834

Office Use Only - MrOS ID# Acoustic Staff ID#

Were any of the HRpQCT scans obtained for this participant?  
 Yes  No → Reason:  Unable  Refused  Scanner Unavailable  Other: \_\_\_\_\_

① Patient Number/Sample Number: \_\_\_\_\_

② Was a DISTAL RADIUS scan obtained?  
 Yes  No, refused  No, unable → Mark all that apply:  
 History of fracture on both sides  
 Hardware on both sides  
 Other: \_\_\_\_\_

A. Ulnar length: \_\_\_\_\_ mm B. Participant's dominant hand:  Left  Right  
 C. Date of distal radius scan: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_  
 (Month Day Year)

D. Which side was scanned?  Left  Right E. Was the non-dominant side scanned?  Yes  No

F. Measurement Number: \_\_\_\_\_ Mark all that apply:  
 History of fracture  Hardware  Other: \_\_\_\_\_

G. Image Quality:  0  1  2  3  4  5 Comments: \_\_\_\_\_

REPEAT SCAN #1 H. Measurement Number: \_\_\_\_\_ I. Image Quality:  0  1  2  3  4  5  
 Refused  
 Comments: \_\_\_\_\_

REPEAT SCAN #2 J. Measurement Number: \_\_\_\_\_ K. Image Quality:  0  1  2  3  4  5  
 Refused  
 Comments: \_\_\_\_\_

PAGE 25 Version 2.0 10-22-2014  
 MrOS ACN HRpQCT  
 MOS 33834

**HRpQCT** 59784

Office Use Only - MrOS ID# Acoustic MISSING

③ Were any of the TIBIA scans obtained?  
 Yes  No, refused  No, unable → Mark all that apply:  
 History of fracture on both sides  Hardware on both sides  
 Injury or surgery related  Other:  
 non-weight bearing for 6 weeks or more in past 12 months (both sides)

A. Tibia length: \_\_\_\_\_ mm B. Participant's dominant foot:  Left  Right  
 C. Which side was scanned?  Left  Right

D. Was the non-dominant side scanned?  Yes  No → Mark all that apply:  
 History of fracture  Hardware  
 Injury or surgery related  Other:  
 non-weight bearing for 6 weeks or more in past 12 months

E. Was a DISTAL TIBIA scan obtained?  
 Yes  No, refused  No, other: \_\_\_\_\_

1. Date of distal tibia scan: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ 2. Measurement Number: \_\_\_\_\_  
 (Month Day Year) 3. Image Quality:  0  1  2  3  4  5  
 Comments: \_\_\_\_\_

REPEAT SCAN #1 4. Measurement Number: \_\_\_\_\_ 5. Image Quality:  0  1  2  3  4  5  
 Refused  
 Comments: \_\_\_\_\_

REPEAT SCAN #2 6. Measurement Number: \_\_\_\_\_ 7. Image Quality:  0  1  2  3  4  5  
 Refused  
 Comments: \_\_\_\_\_

F. Was a PROXIMAL TIBIA scan obtained?  
 Yes  No, refused  No, software/cast unavailable  No, other: \_\_\_\_\_

1. Date of proximal tibia scan: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_ 2. Measurement Number: \_\_\_\_\_  
 (Month Day Year) 3. Image Quality:  0  1  2  3  4  5  
 Comments: \_\_\_\_\_

REPEAT SCAN #1 4. Measurement Number: \_\_\_\_\_ 5. Image Quality:  0  1  2  3  4  5  
 Refused  
 Comments: \_\_\_\_\_

REPEAT SCAN #2 6. Measurement Number: \_\_\_\_\_ 7. Image Quality:  0  1  2  3  4  5  
 Refused  
 Comments: \_\_\_\_\_

PAGE 26 Version 3.0 04-07-2015  
 MrOS ACN HRpQCT  
 MOS 59784

Figure A-1: MrOS Visit 4 HR-pQCT teleform