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| <br><small>Canadian Longitudinal Study on Aging<br/>Étude longitudinale canadienne sur le vieillissement</small> | <b>Title:</b>          | <b>Bone Density by Dual-energy X-ray Absorption (DXA) - Forearm Measurement</b> |                         |              |
|   | <b>Version Date:</b>   | 2017-AUG-09   | <b>Document Number:</b> | SOP_DCS_0018 |
|   | <b>Effective Date:</b> | 2017-NOV-15   |                         |              |
| <b>Data Collection Site (DCS)</b>   | <b>Version:</b>        | 2.3   | <b>Number of Pages:</b> | 7            |

**1.0 Purpose:**

The purpose of this document is to describe the standardized procedure for completing bone mineral density (BMD) measurement of the forearm on the Hologic Discovery A Dual Energy X-Ray Absorptiometry (DXA) machine.

**2.0 Scope:**

This document is to be used by the DCS staff when administering the BMD measurement of the forearm to a participant.

**3.0 Responsibilities:**

It is the responsibility of the DCS staff to perform the procedures as described in the current and approved version of the standard operating procedure.

**4.0 Related Documents:**

- **MAN\_DCS\_0014** – Additional Training for the Dual-energy X-ray Absorptiometry (DXA)
- **SOP\_DCS\_0014** – Bone Density Questionnaire
- **SOP\_DCS\_0043** – Dual- energy X-ray Absorption (DXA) SOP – Calibration (Quality Assurance) and Maintenance
- **SOP\_DCS\_0043** – DEXA Calibration and Maintenance SOP

**5.0 Definitions:**

- **Carpal Bones:** (wrist bones) 2 rows of small bones that are found between the hand and the forearm.
- **Styloid:** usually serving as points of attachment for muscles, refers to the slender, pointed process (protrusion) of Ulna.

**6.0 Equipment:**

- DXA machine (Hologic Discovery A)

**7.0 Supplies:**

- Radiation badges (If required by your institute);
- Hologic Non flexible 30 cm ruler; and,
- Disinfectant spray/Certainty Wipe.

**8.0 Procedure Steps:**

**Contraindications for the questionnaire:**

- Pregnancy;

- Participated in any nuclear medicine studies within the last 2 days;
- Prosthetic arm on both arms;
- Cast on both arms;
- Arteriovenous shunt/fistula in both arms; or,
- Previous breaks or fractures on both arms (not including breaks in the wrist);
- Please make a note of the following conditions from the Contraindications Questionnaire in the comments section of Onyx:
  - Previous breaks or fractures in the wrist;
  - Polio; or
  - Note the test type is participant was involved in nuclear medicine more than 48 hours ago but less than 7 days ago.

### Sponges

Sponges can be used to provide participant comfort or support during DXA scans on an **as needed basis**. The sponge provides comfort to an **already existing** gap; it should not provide a further elevation or a further bend in the knee (i.e., if a participant is unable to place their head against the DXA table during a whole body scan or they already have a slight bend in their knee and require support as they are uncomfortable with holding the position). Sponges are not used to routinely position during bone density, but only in extreme cases where participants need some support from the positioning.

### Performing the Forearm Scan

The left arm is the default. Scan the right forearm when there is a contraindication or other reason for not scanning for the left forearm.

- Step 1:** Before this scan can be performed the Bone Density Questionnaire stage must be completed. Refer to *SOP\_DCS\_0014 - Bone Density Questionnaire* and complete the **Starting the BD Questionnaire** section.
- Step 2:** To start the scan refer to *SOP\_DCS\_0014 - Bone Density Questionnaire* and complete the **Starting Each DXA Scan** section.
- Step 3:** Select **Forearm** (left, or right if left is contraindicated) and then select **Next**.
- Step 4:** On the control panel press **Center**.
- Step 5:** The chair should be positioned at the centre of the table, but not touching. Have the participant place their arm on the table, approximately at the centre point, if possible. If they have sleeves on, the sleeve needs to be pushed up past the elbow.
- Step 6:** Measure the forearm in centimeters, from the tip of the elbow to the small bump on the wrist, with the Hologic ruler (See Figure). Write this measurement down, you will need to use it later for the analyzer step.

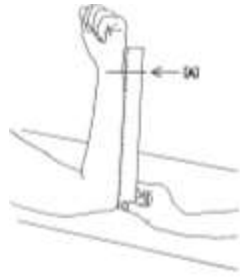
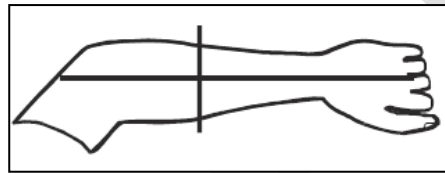
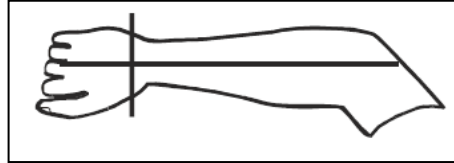


Figure. Measuring the Left Forearm

**Step 7:** The participant should be positioned with their forearm resting on the scanning table, with the hand in a soft fist (see pictures).



Left arm



Right arm

**Step 8:** On the control panel, press **Laser**.

**Step 9:** Use the control panel of the DXA to position the starting point on the forearm. **Use exclusively the Arm arrows. Never touch the Table arrows.**

**Left forearm:** Starts at the mid-forearm. Move the arm back and forth until the laser is parallel to the arm, and in line with the ring finger. Verify that the first row of carpal bones are within 15cm (6in) of the starting point (see picture), use a folded piece of paper to do this.

**Right forearm:** Starts at the first row of carpal bones (see picture). Move the arm back and forth until the laser is parallel to the arm, and in line with the ring finger.

**Step 10:** Warn the patient that the arm of the DXA at the bottom will move towards them and may touch them during the scan. Then click on **Start Scan**.

**WARNING:** if the control panel x-ray indicator fails to shut off within 10 seconds after the end of the scan, press the red Emergency Stop button immediately. Call your Hologic service representative before resuming operation (see DXA Hologic Discovery A Calibration and Maintenance SOP).

**Step 11:** Inspect the image:



- The radius and ulna must appear straight and centred.
- The image shows at least the first row of carpal bones near the bottom for the right forearm scan, or near the bottom for the left forearm scan.
- The ulna side contains at least enough air to equal the ulna's shaft width.

**Step 12:** If the image is not acceptable, click **Reposition Scan**. **On the control panel, use exclusively the Arm arrows. Never touch the Table arrows.**

**Repositioning Scan:**

- Click **Reposition Scan** before the scanning is completed.
- Position the cursor over the forearm image.  
**NOTE:** you can use the scroll bars to reposition the image.

**To position the forearm:**

- Move the first row of carpal bones within the horizontal blue positioning line and the outer limit of the scan field.
- The radius and the ulna should be parallel between the two blue vertical positioning lines.
  - When the forearm is positioned correctly, click **Restart Scan**.
  - Click **Start Scan**.

**Repositioning Participant (if necessary):**

- Adjust the forearm so that it is straight.  
**NOTE:** the participant's forearm should be moved to include or exclude more of the carpal bones.


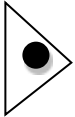
- Click **Restart Scan**.
- Click **Start Scan**.
- Evaluate the image as it displays. If the image is not satisfactory, click **Reposition Scan** before it is complete and repeat **Step 14**.

**Step 13:** If the image is acceptable, allow the scanning to complete.

**Step 14:** When the exam completes, an 'Exit Exam' window box displays. Press **Analyze Scan**.

**Step 15:** An 'Analyze Setup' window will open, click **Next**. Enter the length of the forearm (measured in **Step 11**).

**To make adjustments**

- Click on **Sun/Moon** symbol  on the bottom left of the screen to adjust view of scan
- Move the circle within the triangle to change the lightness or darkness of the scan. 
- Press the **zoom** button twice.
- Click on **Sun/Moon** symbol again to return
- Click on **Global ROI** and center the image using the arrow keys.
- Place the yellow line that is closest to the carpal bones at the tip of the ulna styloid (the ulna is the narrower of the two arm bones).

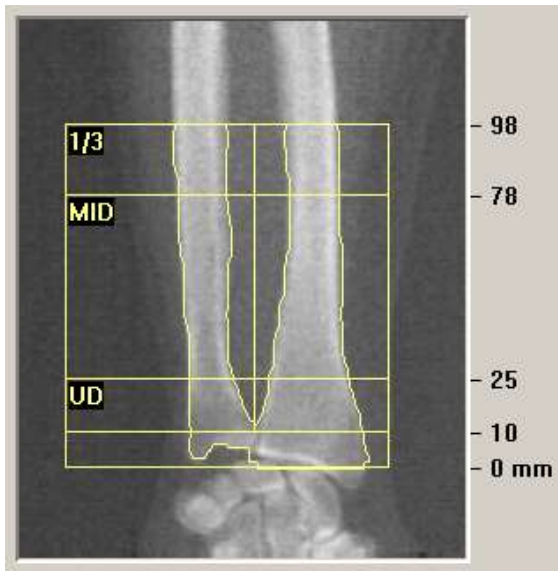
**NOTE:** Carpel bones are at the top of the scan on a left forearm so it is the TOP YELLOW LINE that is of interest. Carpel bones are at the bottom of the scan on a right forearm so it is the BOTTOM YELLOW LINE that is of interest.

- In the Global ROI toolbox click **Line Mode**.
- Adjust the two sidelines to bring the blue dotted lines into the outside edge of bone. Stop at the point where the blue line(s) first touches bone.

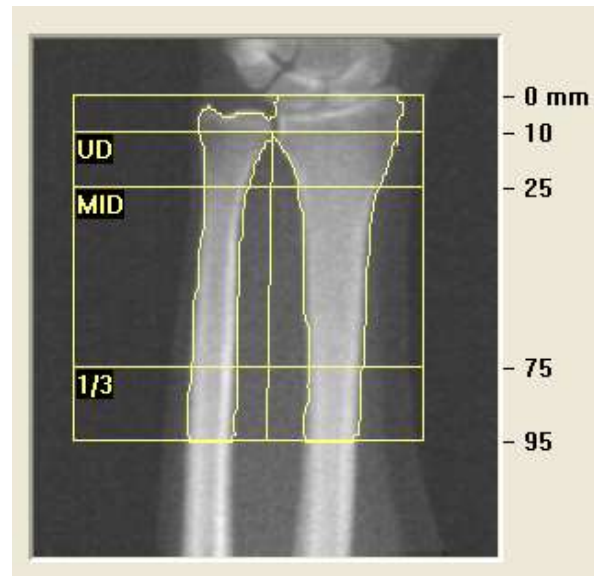
**DO NOT ADJUST THE 1/3 DISTAL LINE. THIS APPLICATION IS USED FOR RESEARCH SITES.**

- Click on **Bone Map**.
- Verify that all bone has been filled in (edit if necessary).
- Click **MID/UD**.
- The line should be going through the space between the end plates and joint of radius / ulna.

- Verify that distal cortical bone is not included in the UD region.



Proper Analysis Right Forearm Scan



Proper Analysis Left Forearm Scan

- Un-zoom by clicking on **Sun/Moon** then **zoom**. Click on the **Sun/Moon** again to return
- Click the **Results** button. To exit from this page, click on **Close**.

**Step 16:** The 'DAP Report' window will open. Click **Ok**.

**Step 17:** Select **Report** and then the 'Select Patient' window will pop up. Click the participant's forearm scan to select (press the ctrl button for the second one), then click on **Next**.

**Step 18:** Minimize the APEX program and go back to Onyx.

**Step 19:** At the *Interview Tab* in Onyx, look for 'Bone density – Forearm' scan in the list of stages. Then select **Start** in that row.

**Step 20:** The "Bone density - Forearm: Start" window will pop up.

**Step 21:** Scan the Interview ID barcode, click on **Continue**.

**Step 22:** Press **Start** in the Instrument application launch to open the Hologic software. A 'Hologic Apex Receiver' box will pop up.

**Step 23:** Go back to the APEX program. Make sure the report type selected is 'Interpreting' with one copy. Select **DICOM/IVA**. Next the 'DICOM/IVA' page will come up, click on **Send**.

**Step 24:** One or two messages will pop up, click on **OK** (after each message) until you are back to the 'DICOM/IVA' page.

**Step 25:** In Onyx press the **Capture** button. Wait until the 2 rows below go green, click on **OK**. Press **Refresh** so that the scans will appear on this page. If there is more than the required amount of scans, delete the appropriate ones.

**Step 26:** Click on **Next**. The 'Bone density – Forearm: Finish' screen will pop up.

**Step 27:** Click **Finish** indicate in the comments field if there was anything that may have affected the measurement. Ensure that comments do not contain any personally identifying information.

**Step 28:** Click **Continue** to return to the *Interview Tab* page.

**Step 3:** Return to the 'APEX program – Report' and click on **Cancel**.

- You will now move on to the next scan. If the participant is unable or unwilling to do this scan, or no further scan is prompted, then refer to the **Final Steps** section of *SOP\_DCS\_0014 - Bone Density Questionnaire*.

### 9.0 Documentation and Forms:

- CRF\_DCS\_0014\_1** – DXA Case Report Form

### 10.0 References:

- Body Composition Procedures Manual. NHANES; 2006.
- Discovery QDR Series: Operator's Manual. Document No. MAN-01794 Revision 002. Hologic, Inc.; 2010.

### F1 Revision History:

| New Version #  | Revision Date | Revision Author | Content Approval |
|--|---------------|-----------------|------------------|
| 2.3  | 2017-AUG-09   | Lorraine Moss   | Harriet Sauve    |
| <b>Summary of Revisions</b>  |               |                 |                  |
| SOP edited to correct the Contraindications and to be noted sections for this measurement.                                       |               |                 |                  |
| Updated section 10.0 to include Discovery QDR series reference.  |               |                 |                  |
| Removed information regarding starting and ending scans  |               |                 |                  |
| General formatting to the document.  |               |                 |                  |
| New Version #  | Revision Date | Revision Author | Content Approval |
| 2.2  | 2015-NOV-18   | Lorraine Moss   | Mark Oremus      |
| <b>Summary of Revisions</b>  |               |                 |                  |
| Added ethnicity to the list of participant information in Step 1 and Step 3. Step 31- moving on to next scan - has been removed. |               |                 |                  |