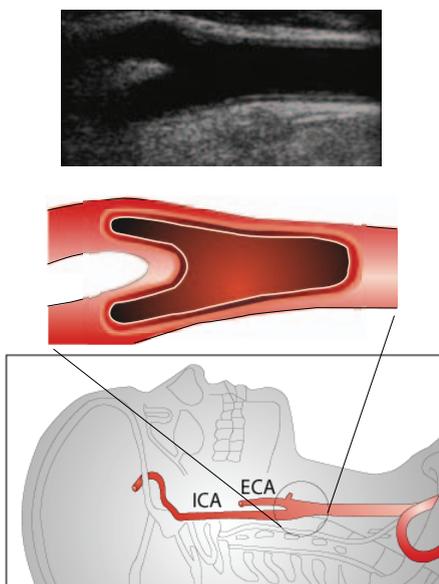

SonoCalc[®] IMT 5.0



User Guide

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Caution: Federal (United States) law restricts this device to sale by or on the order of a physician.

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Table of Contents

| | |
|---|----|
| Introduction | 1 |
| Compatible Transducers | 1 |
| Safety | 2 |
| About the Work Area | 3 |
| Screen Layout | 3 |
| Exam Data Pane | 4 |
| Menus | 8 |
| Patient Images | 9 |
| Setting the Exam Folder | 9 |
| Starting a New Exam | 10 |
| Opening Saved Exams | 10 |
| Patient Information | 11 |
| Image Calibration | 12 |
| Automatic Calibration | 12 |
| Manual Calibration | 12 |
| Image Calibration Verification | 14 |
| Navigation Commands | 15 |
| Navigating Current Image | 15 |
| Navigating Active View | 15 |
| Adjusting IMT Measurements | 16 |
| Navigating between Image Files | 18 |
| Measurements Overview | 19 |
| IMT Measurements | 20 |
| Auto Mode | 20 |
| Sketch Mode | 22 |
| Trace Mode | 26 |
| Setting a Reference Point | 28 |
| Changing Default IMT Measurement Settings | 29 |
| Plaque Measurements | 29 |
| Measurement Results | 30 |
| Selecting Saved Measurements | 30 |
| Regenerating Measurements | 30 |
| Deleting Saved Measurements | 31 |
| Excluding Imported Measurements | 31 |
| Editing Measurements | 31 |
| Reviewing Saved Exams | 32 |
| Manual Calipers | 32 |
| IMT Report | 33 |
| Customizing Report Stationery | 33 |
| Viewing IMT Report | 34 |
| Saving Report as PDF | 34 |
| Printing Report | 34 |
| Graph Setup | 35 |
| Custom IMT Graph Tables | 35 |

| | |
|-------------------------------------|----|
| Exporting Data | 36 |
| Results Summary | 37 |
| References | 37 |
| Distance Measurement Accuracy | 39 |
| Technical Support | 39 |

Introduction

SonoCalc® IMT measures the intima media thickness (IMT) of the carotid artery and plaque using digital ultrasound images. Images from M-Turbo®, S Series™, MicroMaxx®, *TITAN*®, and SonoSite® 180PLUS™ ultrasound systems are typically transferred to a personal computer (PC) using SiteLink™ Image Manager (SiteLink). For NanoMaxx®, M-Turbo, and S Series ultrasound systems, images can be imported from a USB storage device.

You can measure the IMT of the near or far walls of the carotid artery. Images must be obtained using a transducer that is compatible with SonoCalc IMT. SonoCalc IMT generates a report with the patient's IMT value. This information can be used with other medical information to assess the cardiovascular health of a patient.

See the ultrasound system user guide and *SiteLink Image Manager User Guide* for additional information on operating the ultrasound system and transferring images.

Compatible Transducers

SonoCalc IMT is compatible with the following transducers:

Table 1: System and Transducer Compatibility

| Transducer | NanoMaxx | S Series M-Turbo | MicroMaxx | <i>TITAN</i> | 180PLUS |
|-----------------|----------|---------------------|-----------|--------------|---------|
| HFL38x/13-6 MHz | – | ✓ | – | – | – |
| HFL38/13-6 MHz | – | – | ✓ | – | – |
| L38n/10-5 MHz | ✓ | – | – | – | – |
| L38xi/10-5 MHz | – | ✓ | – | – | – |
| L38x/10-5 MHz | – | ✓ | – | – | – |
| L38e/10-5 MHz | – | – | ✓ | – | – |
| L38/10-5 MHz | – | – | – | ✓ | ✓ |
| L25n/13-6 MHz | ✓ | – | – | – | – |
| L25x/13-6 MHz | – | ✓ | – | – | – |
| L25e/13-6 MHz* | – | – | ✓ | – | – |
| L25/10-5 MHz | – | – | – | ✓ | ✓* |

* Images from these transducers are not automatically calibrated on MicroMaxx 3.3 (or earlier) ultrasound systems. The images from 180PLUS or MicroMaxx 3.3 (or earlier) ultrasound systems can be manually calibrated. See [“Manual Calibration” on page 12](#).

Safety

Patient Safety

- WARNING:** To ensure high-quality images, all patient images must be obtained by qualified and trained individuals. See the ultrasound system user guide for information on using the system.
- WARNING:** To avoid misdiagnosis, be aware that the SonoCalc IMT user interface is in English only and follows English-language conventions, although you can import exams from an ultrasound system localized in French, German, Italian, Spanish, or Brazilian Portuguese. The IMT report included with an IMT exam from a non-English ultrasound system may have details formatted differently from those in SonoCalc IMT.
- WARNING:** To avoid measurement errors, all images must be obtained using the NanoMaxx, S Series, M-Turbo, MicroMaxx, *TITAN*, or 180PLUS ultrasound system with a transducer that supports SonoCalc IMT. Images must be transferred in high-resolution bitmap (24 bit) format.
- WARNING:** To avoid patient injury, IMT results should not be used as a sole diagnostic tool. All IMT results should be interpreted in conjunction with other clinical information or risk factors.
- WARNING:** To avoid interpretation errors that might affect patient safety, only a qualified and trained individual should interpret IMT results.
- WARNING:** To avoid interpretation errors that might affect patient safety, IMT measurements that are saved and intended to populate the default graphs should be made only from images of the distal 10 mm of the common carotid artery (CCA). This tool is not intended for measuring the bulb or the internal carotid artery (ICA).
- WARNING:** To avoid patient injury associated with misdiagnosis or measurement errors, verify that the patient information is accurate before transferring images from the ultrasound system and before performing any IMT measurements.
- WARNING:** To avoid patient injury or measurement errors, verify patient information before every exam.
- WARNING:** To ensure accurate age computations, make sure that the date on your computer is correct.
- WARNING:** To avoid misdiagnosis, do not use images from an ultrasound system that has the MBe (SonoMBe™ multi-beam imaging, enhanced) control on. If the ultrasound system supports MBe, turn off MBe before saving images for use in SonoCalc IMT.

Electrical Safety

WARNING: To avoid the risk of electrical shock, connect only cables recommended by SonoSite to peripherals. Contact SonoSite or your local representative for the accessory cable(s) available from or recommended by SonoSite.

WARNING: To avoid the risk of electrical shock, the electrical connection of a personal computer to the ultrasound system must be in a manner that complies with Table BBB.201 of IEC 60601-1-1:2001.

About the Work Area

The SonoCalc IMT work area has menus and three panes: two that display the image and one that displays exam data. The Exam Data pane has patient data, measurement results, and more.

Screen Layout

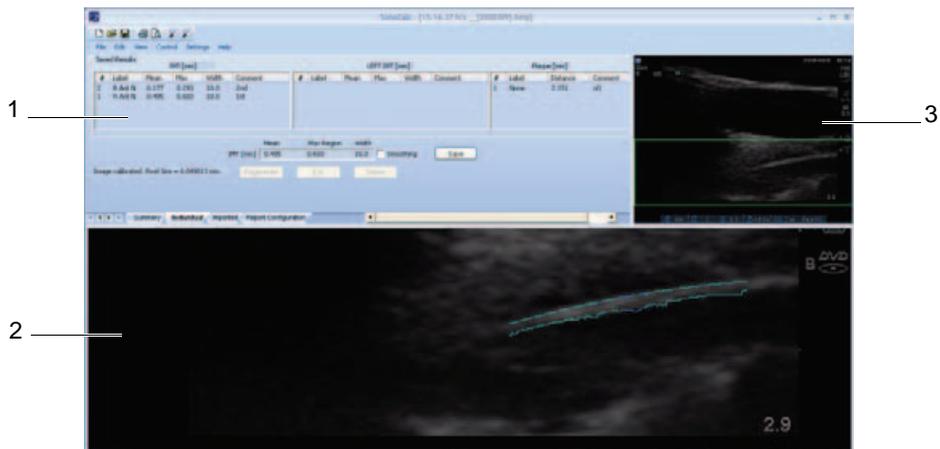


Figure 1 SonoCalc IMT Screen

- | | | |
|---|------------------|--|
| 1 | Exam Data Pane | Displays current and/or saved information and instructional prompts. See “ Exam Data Pane ” on page 4. |
| 2 | Active View Pane | Displays the image for performing measurements and zooming in or out. A status bar below the image displays the screen size in millimeters, x and y coordinates, pixel intensity, and Reference Line data. |

- 3 **Current Image Pane** Displays the entire image and serves as a navigational aid. The green rectangle, the region of interest box (ROI), indicates the portion of the image that currently appears in the Active View pane.

Exam Data Pane

The Exam Data pane contains four tabs: Summary, Individual, Imported, and Report Configuration. Each tab displays current and/or saved information for the selected exam as well as instructional system prompts.

Summary Tab

When SonoCalc IMT first opens, it defaults to the Summary tab. The Summary tab contains Patient Information and Summary Results.

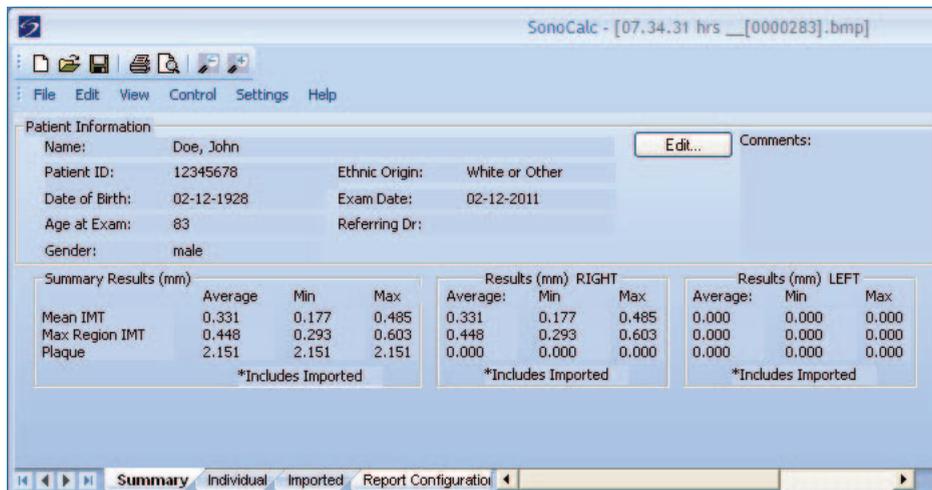


Figure 2 Exam Data Pane: Summary Tab

Patient Information

The Patient Information area displays current patient information including Name, Patient ID, Date of Birth, Age at Exam, Gender, Ethnic Origin, Exam Date, and Referring Dr. Some patient information is editable. See [“Patient Information” on page 11](#).

Summary Results

The Summary Results area displays exam summary measurements for Mean IMT, Max Region IMT, and Plaque. You can print this information or save it as PDF (See [“Printing Report” on page 34](#) and [“Saving Report as PDF” on page 34](#)). If the summary results include imported measurements, an asterisk appears next to the measurement and [“*Includes Imported”](#) appears below the results.

Individual Tab

The Individual tab contains Saved Results and Current Results. The Exam Data pane automatically opens to the Individual tab whenever a measurement is performed or edited.

Saved Results

The Saved Results area displays IMT and Plaque measurement tables. If more measurements are taken than show in the table, you can scroll to view them. You can regenerate or delete measurements as well as edit comments.

- The IMT measurement table displays all saved IMT measurements for the right side and from previous versions of SonoCalc IMT (which did not specify sides). The most recent is first. Each measurement includes the measurement Number, Label, Mean, Max, Width, and Comment data.
- The Left IMT measurement table displays all saved IMT measurements for the left side. The most recent is first. Each measurement includes the measurement Number, Label, Mean, Max, Width, and Comment data.
- The Plaque measurement table displays all saved plaque measurements with the most recent first. Each measurement includes the measurement Number, Label, Distance, and Comment data.

Current Results

The Current Results area displays either IMT or plaque results depending on the active measurement being made. The pixel size for the image currently shown appears beneath the table. For smoothing, select the Smoothing check box. The measurement in the Current Results table can be saved, which automatically adds it to the appropriate Saved Results table.

Imported Tab

The Imported tab contains imported results for IMT, Diameter Reduction, Area Reduction, and Plaque measurements saved on M-Turbo and MicroMaxx ultrasound systems. On the NanoMaxx ultrasound system, the Imported tab contains imported results for IMT and Plaque measurements.

These tables display all saved measurements in the order defined by ultrasound system setup. All measurements displayed in the tables are included in the exam report unless selected and excluded.

WARNING: Before starting an exam, verify that imported measurements are accurate and complete.

- The IMT table displays all saved imported IMT measurements showing Label, Mean, Max, and Width data. If more measurements are taken than show in the table, you can scroll to view them.
- The Diameter Reduction table displays diameter reduction measurements showing Label, Dist 1, Dist 2, and % Diameter Reduction data.
- The Area Reduction table displays area reduction measurements showing Label, Area 1, Area 2, and % Area Reduction data.

- The Plaque table displays all saved plaque measurements showing Label and Distance data.

Exclude from Exam lets you select which imported results you want to include in report averages. See [“Excluding Imported Measurements” on page 31](#).

Report Configuration Tab

The Report Configuration tab lets you specify how data are plotted in the graphs that appear in the report. You can also exclude graphs from the report.

Specify how data plot in graphs

❖ Do the following under **First Plot** and **Second Plot**:

- a Select **Show**.
- b Under **Value to Plot**, select a measurement type. (See also [“Value to Plot list” on page 7](#).)
- c Specify the population to plot against:

WARNING: Prior to use, verify that custom table data entries are correct. SonoSite recommends previewing the report before using for an exam.

- To use data from the default IMT graph tables, select **Default**. The **Plot values against population data from** field is filled automatically.
- To use data from a custom IMT graph table that you have set up, deselect **Default**, and then select the custom IMT graph table from the **Plot values against population data from** list. (Only graph tables for a population of the same gender as the patient are available.)

For more information on the IMT graph tables and customizing them, see [“Graph Setup” on page 35](#).

Exclude graphs from report

- ❖ Deselect **Show** under the plot or plots you want to exclude:
- First Plot
 - Second Plot

Value to Plot list

The default measurement types in the Value to Plot list are as follows.

Value to Plot list

| Measurement Type | Definition |
|----------------------------------|--|
| Average CCA Mean IMT | Average of individual measurements of CCA mean IMT |
| Minimum CCA Mean IMT | Smallest of individual measurements of CCA mean IMT |
| Maximum CCA Mean IMT | Greatest of individual measurements of CCA mean IMT |
| Right Average CCA Mean IMT | Average of individual measurements of CCA mean IMT on right side |
| Right Minimum CCA Mean IMT | Smallest of individual measurements of CCA mean IMT on right side |
| Right Maximum CCA Mean IMT | Greatest of individual measurements of CCA mean IMT on right side |
| Left Average CCA Mean IMT | Average of individual measurements of CCA mean IMT on left side |
| Left Minimum CCA Mean IMT | Smallest of individual measurements of CCA mean IMT on left side |
| Left Maximum CCA Mean IMT | Greatest of individual measurements of CCA mean IMT on left side |
| Average CCA Max Region IMT | Average of individual 1mm measurements of maximal CCA IMT |
| Minimum CCA Max Region IMT | Smallest of individual 1mm measurements of maximal CCA IMT |
| Maximum CCA Max Region IMT | Greatest of individual 1mm measurements of maximal CCA IMT |
| Right Average CCA Max Region IMT | Average of individual 1mm measurements of maximal CCA IMT on right side |
| Right Minimum CCA Max Region IMT | Smallest of individual 1mm measurements of maximal CCA IMT on right side |

Value to Plot list (Continued)

| Measurement Type | Definition |
|----------------------------------|--|
| Right Maximum CCA Max Region IMT | Greatest of individual 1mm measurements of maximal CCA IMT on right side |
| Left Average CCA Max Region IMT | Average of individual 1mm measurements of maximal CCA IMT on left side |
| Left Minimum CCA Max Region IMT | Smallest of individual 1mm measurements of maximal CCA IMT on left side |
| Left Maximum CCA Max Region IMT | Greatest of individual 1mm measurements of maximal CCA IMT on left side |
| Maximal Average CCA Mean IMT | Average of individual measurements of CCA mean IMT, in whichever side has the greatest one |
| Minimal Average CCA Mean IMT | Average of individual measurements of CCA mean IMT, in whichever side has the smallest one |

Menus

SonoCalc IMT has six menus:

- File** Provides commands for opening patient image files for new or saved patient exams, viewing previously saved images, printing the patient report, saving exams, and exporting data.
- Edit** Opens Patient Information screen for editing.
- View** Provides the option for viewing or hiding the status bar and the tool bar. Lets you specify the background color.
- Control** Provides commands for performing, manipulating, saving, and clearing IMT measurements and for calibrating the image.
- Settings** Provides commands for report and measurement settings and for specifying the exam folder.
- Help** Provides online Help and license information.

Specify the background color

- ❖ From the **View** menu, select **Style (color)**, and then select the desired color.

Patient Images

Patient images are organized into exam files for patients. These files contain data as well as image information. For SonoCalc IMT to operate properly, you must keep data and report files associated with image files together.

Moving files is not recommended. If you must move files, be certain to move the entire Study folder for that patient.

Do not remove, modify, or duplicate any files in the folder.

Patient images can be transferred to SonoCalc IMT as follows:

- Transfer from SiteLink: M-Turbo, S Series, MicroMaxx, TITAN, and 180Plus
- Import from USB storage device: M-Turbo, S Series, and NanoMaxx

Ensure that all images are transferred in high-resolution bitmap (24 bit) format. Access these files for existing or new patients when starting a new exam or opening a saved exam.

WARNING: To avoid loss of patient information, use extreme care when moving patient images once they are transferred to your PC. Improperly moving image files may cause errors in SonoCalc IMT operations.

Setting the Exam Folder

By default, exams save to the C:\SonoCalc\ExamData\ folder. You can change this folder.

You can view and edit exams from an earlier version of SonoCalc by setting the exam folder to the location of the earlier version (C:\Program Files\SonoSite\SonoCalc\ by default). In Microsoft Vista, these exams need to be moved before they can be modified.

If you want to keep groups of exams separate, you can use different storage locations.

Set the Exam Folder

- 1 From the **Settings** menu, select **Exam Folder**.
- 2 Browse to a folder.

If you want to make a new folder, browse to the location, and click **Make New Folder**. A new folder with an editable folder name appears. Type a name (or right-click the folder name and select **Rename**).

- 3 Click **OK**.

Starting a New Exam

Up to nine exams can be created for a particular patient on a given day.

Start New Exam

- 1 From the **File** menu, select **New Exam**.
The Open dialog box appears.
- 2 Open a patient image.
The Select a Patient dialog box appears.
- 3 Select **New Patient** or an existing patient.
If you select **New Patient**, the Patient Information screen appears. Fill in the appropriate fields. See [“Patient Information” on page 11](#).
The first time SonoCalc IMT starts, the only option is New Patient.
- 4 Click **OK**.

Opening Saved Exams

Exams that have been saved can be opened at any time. Saved exams are assigned a date at the time they are completed in SonoCalc IMT. This date may be different from the date the images were taken.

Open Saved Exam

- 1 From the **File** menu, select **Open Saved Exam**.
The Open Saved Exam dialog box appears.
Groups of saved measurements are listed and identified as Measures.kpt or Measures.xml.
If a previous file has been reviewed and other measurements are performed, each modified exam is stored in a new file with a new file name, for example, Measures.xml or Measures.kpt.
Note: If you open an exam saved in a previous version, SonoCalc IMT prompts you to update user-defined tables.
- 2 Select the desired file.
The patient information and all saved measurements for this patient exam open.
- 3 Click **OK**.
The patient image opens.
The first measurement, 1 in the # list, is automatically regenerated and displayed on the active image, if available.
If any of these saved measurements are deleted or new measurements are added, a new file is generated for this exam. The original file remains intact.

To regenerate other saved measurements for this file, see [“Regenerating Measurements” on page 30](#).

Note: Enhancements to the system software may cause small insignificant measurement differences in exams from an earlier version of SonoCalc IMT that are regenerated.

Patient Information

WARNING: To avoid patient injury associated with misdiagnosis or measurement errors, verify that the patient information is accurate before transferring images from the ultrasound system and before performing any IMT measurements.

To enter patient information into the Patient Information screen, start a new exam. (See [“Starting a New Exam” on page 10](#).)

Some patient information may be automatically entered.

Complete all applicable fields. Fields with an asterisk are required.

- **Last Name:** Patient's last name.
- **First Name:** Patient's first name. Optionally, add a space and the middle name or initial.
- **ID:** Patient's ID. (Optional)
- **Date of Birth:** Year, month, and day of birth. This date must reflect an age at exam of five to 100 years.
- **Age at Exam:** Patient's age on the date of exam.
- **Gender:** Male or Female.
- **Ethnic Origin:** Patient's ethnic origin.
- **Date of Exam:** Year, month, and day of the exam, if not automatically entered.
- **Referring Dr:** Physician's full name. (Optional)
- **Comments:** Additional information about the patient. Press CTRL+ENTER to start a new line of text. (Optional)
- **Image Frame Selection:** Non-ECG Gated (default) or ECG R Wave Gated.

Modify Patient Information:

- ❖ Do one of the following:
 - Select **Patient Information** from the **Edit** menu.
 - Click **Edit** on the Summary tab.

Image Calibration

Images are automatically calibrated if they meet certain criteria. See [“Automatic Calibration.”](#)

The SonoCalc IMT measurement tools operate only on calibrated images. If the image is not automatically calibrated, you can perform a manual calibration. It is the user’s responsibility to perform an accurate manual calibration on any image that cannot be automatically calibrated.

WARNING: To avoid measurement errors, all patient images must be calibrated.

WARNING: To avoid measurement errors, always verify that the automatic calibration data matches the information on the current image. If the ultrasound image or annotation covers the depth markers, the automatic calibration may incorrectly calibrate the current image resulting in incorrect measurement results.

Automatic Calibration

Before starting an IMT measurement, always verify that the image calibration data matches the information on the current image. All patient images transferred from the NanoMaxx, S Series, M-Turbo, MicroMaxx, TITAN, and 180PLUS ultrasound systems are automatically calibrated if they meet the following criteria:

- Image acquired using a transducer that is compatible with SonoCalc IMT. See [“Compatible Transducers” on page 1.](#)
- Image transferred and saved in high-resolution bitmap (24 bit) format. For instructions on selecting file formats, see the *SiteLink Image Manager User Guide*, *NanoMaxx Ultrasound System User Guide*, *S Series Ultrasound System User Guide*, or *M-Turbo Ultrasound System User Guide*.

For information on verifying calibrations, see [“Image Calibration Verification” on page 14.](#)

Manual Calibration

WARNING: If an image is manually calibrated, it is not recognized as a valid SonoSite image. Measurements performed on the image may be inaccurate. (SonoCalc IMT should be used only on images in which the pixel scale is 1:1.)

Note: If SonoCalc IMT is unable to automatically calibrate an image, the following message appears: “Could not Auto-Calibrate.” SonoSite recommends using the depth markers on the right side of the image as landmarks for calibration.

Calibrate Image Manually

Note: Before performing a manual image calibration, select two points between which you know the distance. You can use this distance to verify accurate calibration.

- 1 Open the patient image.
- 2 In the Current Image pane, click the first calibration landmark to center the ROI box over the landmark.

Use the depth markers as calibration landmarks.

Zoom the image to ensure that the individual pixels on the depth markers are visible on the first calibration landmark. See [“Navigating Active View” on page 15](#) for instructions to zoom.

Re-centering the ROI box may be necessary after zooming.

3 Press the C key.

4 In the Active View pane, click a pixel/location on the first calibration landmark to set as the anchor pixel.

The calibration landmark is a shape composed of many pixels.

It does not matter which pixel/location in the calibration landmark is selected for the anchor pixel, but it is very important that the corresponding pixel/location on the second calibration landmark is selected for the second point.

5 In the Current Image pane, click the second calibration landmark to center the ROI box over the calibration landmark.

6 In the Active View pane, click the corresponding pixel/location that was selected for the anchor pixel/location to set the second point.

A dialog box displays the following text: “How many millimeters between calibration points?”

7 Enter the distance, in millimeters, between the two calibration landmarks. For example, if there is 1 cm between the landmarks, enter 10 (10 mm = 1 cm).

As a secondary check, see [“Manual Calipers” on page 32](#) to measure the distance between the two previously determined points with a known distance. The distance between the points should be the same.

8 Press the ESC key to cancel the calibration process.

Image Calibration Verification

Before starting an IMT measurement, always verify that the image calibration data match the information on the current image.

WARNING: To avoid measurement errors, always verify that the automatic calibration data matches the information on the current image. If the ultrasound image or annotation covers the depth markers, the automatic calibration may incorrectly calibrate the current image resulting in incorrect measurement results.

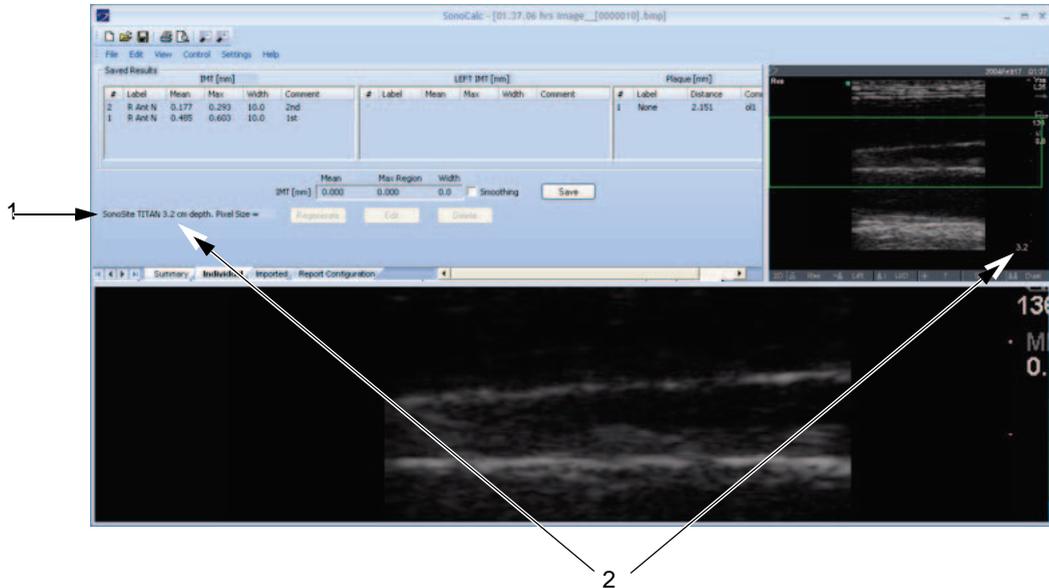


Figure 3 Calibration data on image and in Current Results area:

- 1 - Name of ultrasound system
- 2 - Image depth

Verify Automatic Image Calibration

- 1 Verify that the name of the ultrasound system displayed in the Current Results area matches the system used to acquire the image. See [Figure 3](#).
- 2 For 180PLUS and TITAN ultrasound systems, verify that the image depth in the Current Results area matches the depth in the Current Image pane.

The image depth is the distance from the skinline to the bottom of the ultrasound image.

For zoomed images, “zoom” appears after the image depth in Current Results area.

If the name or depth do not match, perform a manual calibration. See [“Calibrate Image Manually”](#) on page 12.

Navigation Commands

Navigation commands control functions such as adjusting IMT measurements and navigating between image files.

WARNING: On some international keyboards, you may not be able to manually adjust the purple Adventitia Constraint Line. SonoSite recommends manually adjusting other constraint lines or performing the measurement using Sketch mode.

WARNING: International keyboards may use different key combinations.

Navigating Current Image

The following procedures navigate the region of interest (ROI) box in the Current Image pane (upper left corner). The ROI box appears in the Active View pane.

Center ROI Box

- ❖ Click where you want to center the ROI box.

Position ROI Box

- ❖ Drag the ROI box to the desired location.
The image area in the ROI box appears in the Active View pane.

Navigating Active View

The following commands navigate and control the Active View pane (lower image).

| Keys | Description |
|-----------------------|-------------------------|
| Any of the following: | Zooms out on the image. |
| • F5 | |
| • MINUS SIGN | |
| • SHIFT+MINUS SIGN | |
| • SHIFT+COMMA | |

| Keys | Description |
|--|---|
| Any of the following: <ul style="list-style-type: none"> • F6 • PLUS SIGN • = • SHIFT+PERIOD | Zooms in on the image. |
| Mouse wheel | Rotating the mouse wheel moves the image up and down. |
| SPACEBAR-click | Recenters the image. |

Adjusting IMT Measurements

The following commands are available when the IMT measurement is active (IMT measurement boundary lines are visible):

Adjust Measurement Lines Laterally (Auto, Sketch, and Trace Modes)

| Keys | Description |
|------------------|---|
| LEFT ARROW | Moves the IMT measurement region left 1 pixel. |
| CTRL+LEFT ARROW | Moves the IMT measurement region left 10 pixels. |
| RIGHT ARROW | Moves the IMT measurement region right 1 pixel. |
| CTRL+RIGHT ARROW | Moves the IMT measurement region right 10 pixels. |
| UP ARROW | Increases the width of the IMT measurement region by 2 pixels. |
| CTRL+UP ARROW | Increases the width of the IMT measurement region by 20 pixels. |
| DOWN ARROW | Decreases the width of the IMT measurement region by 2 pixels. |
| CTRL+DOWN ARROW | Decreases the width of the IMT measurement region by 20 pixels. |

Adjust Measurement Lines Vertically (Auto, Sketch, and Trace Modes)

Adjust Lumen/Intima Boundary Lines

| Keys <i>Any of the following:</i> | Description |
|---|--|
| <ul style="list-style-type: none">• F9• { | Moves the Lumen/Intima constraint line down, which moves the linked cyan Lumen/Intima IMT measurement boundary line. |
| <ul style="list-style-type: none">• F10• } | Moves the Lumen/Intima constraint line up, which moves the linked cyan Lumen/Intima IMT measurement boundary line. |

Adjust Media/Adventitia Boundary Lines

| Keys <i>Any of the following:</i> | Description |
|---|--|
| <ul style="list-style-type: none">• F11• [| Moves the dark Media magenta constraint line down, which moves the linked cyan Media/Adventitia IMT measurement boundary line. |
| <ul style="list-style-type: none">• F12•] | Moves the dark Media magenta constraint line up, which moves the linked cyan Media/Adventitia IMT measurement boundary line. |
| <ul style="list-style-type: none">• F7• CTRL+[| Moves the purple Adventitia constraint line down, which moves the linked cyan Media/Adventitia IMT measurement boundary line. |
| <ul style="list-style-type: none">• F8• CTRL+] | Moves the purple Adventitia constraint line up, which moves the linked cyan Media/Adventitia IMT measurement boundary line. |

In Sketch or Trace mode, you can also move the measurement boundary lines by dragging.

Drag a Measurement Boundary Line (Sketch or Trace Mode)

- 1 Move the mouse over a manually placed constraint line to highlight it.
- 2 Drag the constraint line to a new vertical location which moves the linked IMT measurement boundary line.

Display Lines

| Keys | Description |
|---|--|
| D | Displays/hides the measured boundary lines. It is useful to display/hide the IMT boundary lines once a measurement is made to see how well the boundary lines were placed. |
| SHIFT+D | Displays/hides the construction constraint lines used for finding the Intima-Media boundaries. It is useful to display the constraint lines when using the bracket/brace adjustments to see the effects of these adjustments. |
| ESC | Clears all IMT measurements, boundary and constraint lines, and reference point from the image. |
| O | Smooths the Adventitia boundary line. Not available in Trace mode. |
| <i>Any of the following:</i> <ul style="list-style-type: none">• F4• / | Changes the orientation for identifying the boundaries used in the IMT measurement. This is useful when measuring the near wall if the jugular vein is next to it. Available in Auto mode only. |

Navigating between Image Files

| Keys | Description |
|---------|--|
| R | Reviews the next image in the folder. |
| SHIFT+R | Reviews the previous image in the folder. |
| F | Forwards the current measurement region, boundary and constraint lines, and reference point to the next image in the folder. |
| SHIFT+F | Forwards the current measurement region, boundary and constraint lines, and reference point to the previous image in the folder. |

Measurements Overview

- WARNING:** To ensure high quality images, all patient images must be obtained by qualified and trained individuals. See the ultrasound system user guide for information on using these systems.
- WARNING:** To avoid measurement errors, all images must be obtained using the NanoMaxx, S Series, M Turbo, MicroMaxx, *TITAN*, or 180PLUS ultrasound systems using a transducer that is compatible with SonoCalc IMT, and all patient images must be transferred in high-resolution bitmap (24 bit) format.
- WARNING:** To avoid patient injury, IMT results should not be used as a sole diagnostic tool. All IMT results should be interpreted in conjunction with other clinical information or risk factors.
- WARNING:** To avoid interpretation errors that might affect patient safety, IMT measurements that are saved and intended to populate the default graphs should be made only from images of the distal 10 mm of the common carotid artery (CCA). This tool is not intended for measuring the bulb or the internal carotid artery (ICA).
- WARNING:** To avoid patient injury associated with misdiagnosis or measurement errors, verify that the patient information is accurate before transferring images from the ultrasound system and before performing any IMT measurements.

There are three modes for performing IMT measurements:

- Auto mode
- Sketch mode
- Trace mode

There is one tool for performing plaque measurements: Plaque Measurements.

When you perform a measurement, SonoCalc IMT displays the following information in the Current Results area. IMT or Plaque measurement results are displayed based upon the active tool.

- IMT (mm)
 - Mean
 - Max Region
 - Width
- Plaque (mm)
 - Distance

When you save the measurement, SonoCalc IMT displays the following information in the Saved Results area:

- IMT (mm), if right side is selected; or LEFT IMT (mm), if left side is selected
 - Label
 - Mean
 - Max

- Width
- Comment
- Plaque (mm)
 - Label
 - Distance
 - Comment

IMT Measurements

You can perform IMT measurements in Auto, Sketch, or Trace mode. Each mode uses colored measurement lines.

You can also set a reference point.

Auto Mode

Auto mode provides automatic IMT measurements based on the user-defined location.

Auto Measurement Lines

The figure and table below show the lines available, their colors, and names as they appear for an auto measurement.

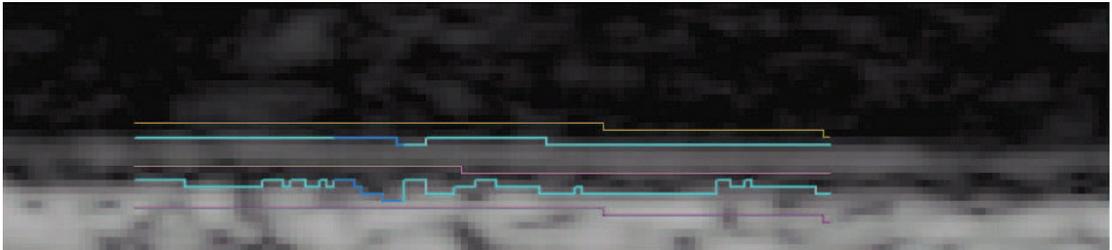


Figure 4 Auto Measurement Lines

Table 2: Auto Measurement Lines

| Color | Name |
|---------|--------------------------------|
| Yellow | Lumen Constraint Line |
| Cyan | Lumen/Intima Boundary Line |
| Magenta | Dark Media Constraint Line |
| Cyan | Media/Adventitia Boundary Line |
| Purple | Adventitia Constraint Line |

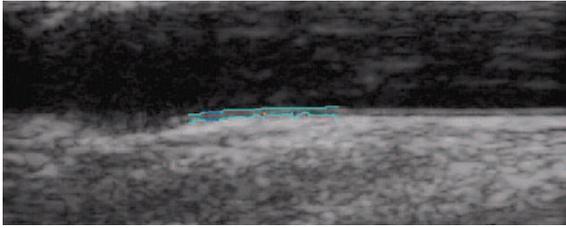


Figure 5 IMT Measurement: Auto Mode

Measuring with Auto Mode

Perform Auto Measurement

Note: If the shortcut keys don't work, ensure that the CAPS LOCK key is off.

- 1 On a patient image, right-click the Media/Adventitia boundary or press the A key and then right-click. See [Figure 5](#).

Two boundary lines appear to identify the IMT measurement region.

- The boundary line toward the Lumen designates the Lumen/Intima boundary.
- The other boundary line designates the Media/Adventitia boundary.

You can adjust the measurement region. See [“Adjusting IMT Measurements” on page 16](#).

To achieve the desired results, SonoSite recommends the following:

- Use Auto mode for IMT measurements.
 - If the desired results cannot be achieved using the adjustments referenced above, try Sketch or Trace mode. See [“Sketch Mode” on page 22](#) or [“Trace Mode” on page 26](#).
 - If you are unable to generate an IMT measurement at the desired location, abandon the image and go to the next one.
- 2 Inspect the trace to confirm that the location of the IMT measurement region and the boundary lines are correct.
 - 3 Click **Save** on the Individual tab, or press the s key.
The Saved Measurement Tag dialog box appears.
 - 4 Do the following, and then click **Save**:
 - Select **Left** or **Right**.
 - Select a tag from the list.
 - (Optional) Enter a comment.

The measurement is saved and the IMT value appears in the Saved Results area.

Up to 24 measurements may be saved for each patient exam.

Repeat these steps until all measurements are performed.

Use the R key to review the next image and the SHIFT+R keys to review the previous image.

Sketch Mode

Sketch mode locates the IMT between two user-defined sketch lines that can be adjusted manually.

Sketch Measurement Lines

The figure and table below show the lines available, their colors, and names as they appear for a sketch measurement.

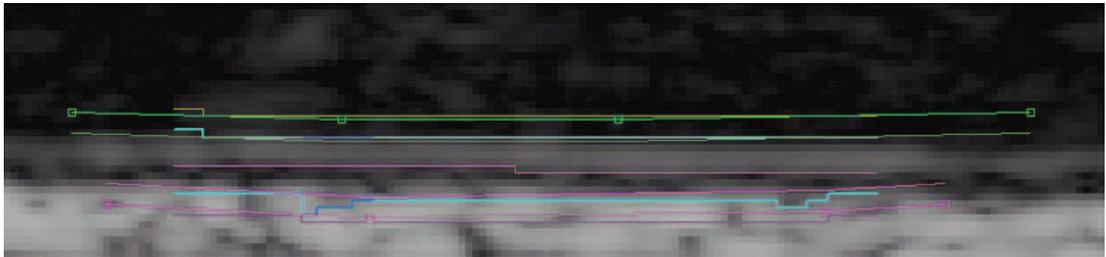


Figure 6 Sketch Measurement Lines

Table 3: Sketch Measurement Lines

| Color | Name |
|----------------------|-------------------------------------|
| Yellow | Lumen Constraint Line |
| Green, with Points | Sketched Lumen Constraint Line |
| Cyan | Lumen/Intima Boundary Line |
| Green | Limit Lumen Edge Line |
| Magenta | Dark Media Constraint Line |
| Magenta | Limit Adventitia Edge Line |
| Cyan | Media/Adventitia Boundary Line |
| Magenta, with Points | Sketched Adventitia Constraint Line |
| Purple | Adventitia Constraint Line |

Measuring with Sketch Mode

There are three methods for measuring with Sketch mode:

- Single Line Sketch
- Double Line Sketch
- Sketch Trace

Perform Single Line Sketch

- 1 On a patient image, press the **K** key.
- 2 Click to place two or more reference points inside the white Adventitia following the contour of the layers consistently parallel to the approximate Media/Adventitia boundary. Make the line slightly longer than the actual segment being measured.

A sketch line connects the points.

If necessary, remove the most recently-added point by pressing the **BACKSPACE** key.

- 3 Right-click anywhere on the image to auto-generate the boundary lines.
If necessary, adjust the measurement region to 10 mm using the **UP ARROW** or **DOWN ARROW** key.

- 4 Click **Save** on the Individual tab, or press the **S** key.

The Saved Measurement Tag dialog box appears.

- 5 Do the following, and then click **Save**:

- Select **Left** or **Right**.
- Select a tag from the list.
- (Optional) Enter a comment.

The measurement is saved and the IMT value appears in the Saved Results area.

Up to 24 measurements may be saved for each patient exam.

Repeat these steps until all measurements are performed.

Use the **R** key to review the next image and the **SHIFT+R** keys to review the previous image.

Perform Double Line Sketch

- 1 On a patient image, press the **K** key.
- 2 Click to place two or more reference points inside the white Adventitia following the contour of the layers consistently parallel to the approximate Media/Adventitia boundary. Make the line slightly longer than the actual segment being measured.

A sketch line connects the points.

If necessary, remove the most recently-added point by pressing the **BACKSPACE** key.

- 3 Click to place a reference point inside the black Lumen consistently parallel to the approximate Lumen/Intima boundary.

- 4 Click to place one or more additional reference points. Make the line slightly longer than the actual segment being measured.

A second sketch line connects the points.

- 5 Place a point to the right of the Media/Adventitia sketch line or right-click anywhere on the image.

If necessary, adjust the measurement region to 10 mm using the UP ARROW or DOWN ARROW key and by adjusting the vertical constraint lines.

- 6 Click **Save** on the Individual tab, or press the S key.

The Saved Measurement Tag dialog box appears.

- 7 Do the following, and then click **Save**:

- Select **Left** or **Right**.
- Select a tag from the list.
- (Optional) Enter a comment.

The measurement is saved and the IMT value appears in the Saved Results area.

Up to 24 measurements may be saved for each patient exam.

Repeat these steps until all measurements are performed.

Use the R key to review the next image and the SHIFT+R keys to review the previous image.

Perform Sketch Trace

- 1 On a patient image, press the K key.

- 2 Click to place reference points directly on the Media/Adventitia border of the Intima/Media layer. Make the line slightly longer than the actual segment being measured.

Do not put the points inside the Adventitia as in the other sketch modes.

A sketch line connects the points.

- 3 Click to place reference points directly on the Lumen/Intima border of the Intima/Media layer. Place these points as precisely as possible and make the line slightly longer than the actual segment being measured.

Do not put the points inside the Lumen as in the other Sketch mode methods.

A sketch line connects the points.

If necessary, remove the most recently-added point by pressing the BACKSPACE key.

- 4 Place a point to the right of the Media/Adventitia sketch line or right-click anywhere on the image.

- 5 If the Lumen edge requires limiting, place the cursor directly on the green Lumen constraint line at one of the edges.

The line becomes brighter.

- 6 Move the cursor toward the cyan boundary line, and then click.

A menu appears.

- 7 Select **Limit Lumen Edge**.
- 8 If the Adventitia edge requires limiting, place the cursor directly on the magenta dotted Adventitia constraint line at one of the edges.
The line becomes brighter.
- 9 Move the cursor toward the cyan boundary line, and then click.
A menu appears.
- 10 Select **Limit Adventitia Edge**.
- 11 Move the Lumen and Adventitia constraint lines until the cyan boundary lines stabilize (at least three pixels).
- 12 If necessary, adjust the measurement region to 10 mm using the UP ARROW or DOWN ARROW key and by adjusting the vertical constraint lines.
- 13 Click **Save** on the Individual tab, or press the S key.
The Saved Measurement Tag dialog box appears.
- 14 Do the following, and then click **Save**:
 - Select **Left** or **Right**.
 - Select a tag from the list.
 - (Optional) Enter a comment.The measurement is saved and the IMT value appears in the Saved Results area on the Individual tab.
Up to 24 measurements may be saved for each patient exam.

Repeat these steps until all measurements are performed.

Use the R key to review the next image and the SHIFT+R keys to review the previous image.

Trace Mode

Trace mode defines the IMT measurement solely from the user-defined location.

Trace Measurement Lines

The figure and table below show the lines available, their colors, and names as they appear for a trace measurement.

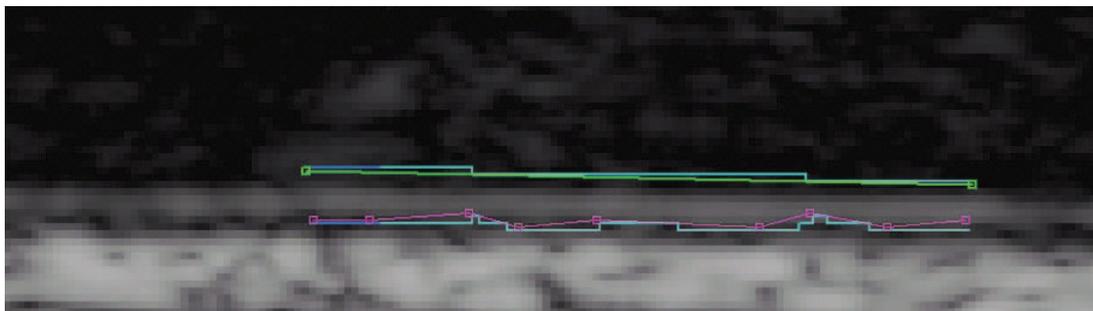


Figure 7 Trace Measurement Lines

Table 4: Trace Measurement Lines

| Color | Name |
|----------------------|--------------------------------|
| Green, with Points | Traced Lumen/Intima Line |
| Cyan | Lumen/Intima Boundary Line |
| Magenta, with Points | Traced Adventitia Line |
| Cyan | Media/Adventitia Boundary Line |

Measuring with Trace Mode

Perform Trace

- 1 On a patient image, press the τ key.
- 2 Start at the left portion of the measurement region and click to place reference points on the Media/Adventitia boundary. See [Figure 8](#).

Be sure to stay on the Media/Adventitia boundary.

If too great a distance is spanned when the Media/Adventitia boundary is curving, the path will deviate from the actual border. In this case, press the BACKSPACE key and add points closer together to keep this line on the Media/Adventitia border.

The straighter the Media/Adventitia boundary, the farther the points can be from each other.

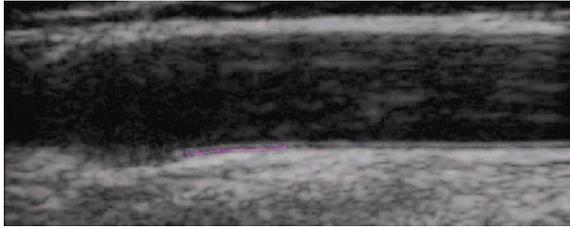


Figure 8 Adventitia Points: Trace Mode

- 3 Start at the left portion of the measurement region and click to place reference points on the Lumen/Intima boundary. See [Figure 9](#).

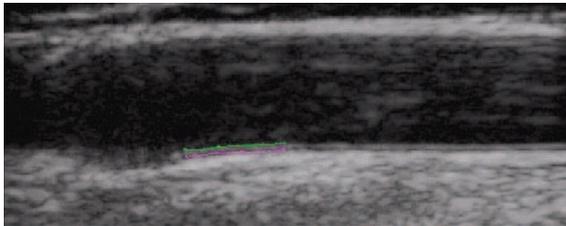


Figure 9 Adventitia Points and Lumen Path: Trace Mode

The measurement is completed when a point is placed to the right of the Media/Adventitia boundary. See [Figure 10](#).

If necessary, press the BACKSPACE key to remove the most recently added point.

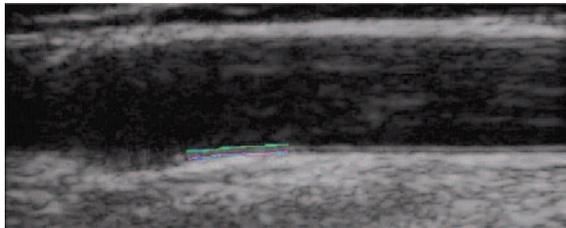


Figure 10 IMT Measurement: Trace Mode

- 4 Inspect the trace to confirm that the location of the IMT measurement region and the boundary lines are correct.
- 5 Click **Save** on the Individual tab, or press the s key.

The Saved Measurement Tag dialog box appears.

- 6 Do the following, and then click **Save**:

- Select **Left** or **Right**.
- Select a tag from the list.
- (Optional) Enter a comment.

The measurement is saved and the IMT value appears in the Saved Results area on the Individual tab.

Up to 24 measurements may be saved for each patient exam.

Repeat these steps until all measurements are performed.

Use the R key to review the next image and the SHIFT+R keys to review the previous image.

Setting a Reference Point

It may be useful to mark the location of the dilation point to be used as a distance baseline when performing IMT measurements.

Set Reference Point

- 1 On a patient image, press the TAB key.
- 2 Click the first reference point along the Media/Adventitia boundary just before the vessel dilates.
- 3 Click the second reference point to the right and along the Media/Adventitia boundary.
A red line parallel to the vessel wall appears.
Use the UP ARROW and DOWN ARROW keys to align the line at the Media/Adventitia boundary.

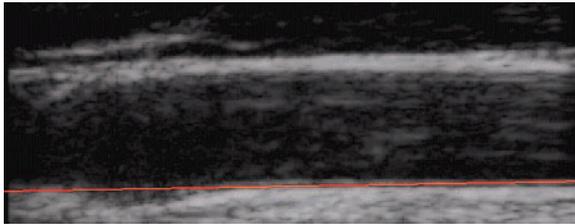


Figure 11 Reference Line

- 4 Click the third point on the Reference Line where the Media/Adventitia boundary starts to curve away from the Reference Line, indicating the start of the vessel dilation.
A vertical red line appears.

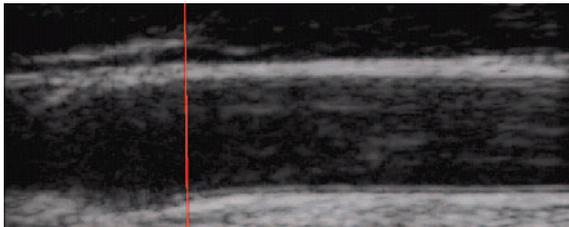


Figure 12 Reference Point

IMT measurements performed after setting the reference point have additional measurement results. If an auto measurement is performed, information appears in the status bar: for example, “Left and Right from Reference Line-5.324, 15.324 mm” and “Center to Reference -10.324 mm.”

Changing Default IMT Measurement Settings

The recommended width for the IMT measurement region is 10 mm.

Change Default IMT Measurement

- 1 From the **Settings** menu, select **Measurement Settings**.
- 2 Enter the desired width for the IMT measurement region in mm.
- 3 Click **OK**.

Plaque Measurements

The plaque measurement tool measures a linear distance representing plaque in the carotid artery.

Current plaque measurements appear on the Individual tab in the Current Results area. For more information, see “[Measurement Results](#)” on page 30. Only one plaque measurement can be taken at a time.

A maximum of four plaque measurements can be imported from NanoMaxx, M-Turbo, or MicroMaxx ultrasound systems.

Take Plaque Measurement

- 1 On a patient image, press the P key to activate the plaque measurement tool.
- 2 Click to place the first measurement point.
- 3 Click to place the second measurement point.

The measurement results appear in the Current Results area.

- 4 Click **Save** on the Individual tab, or press the S key.

The Saved Measurement Tag dialog box appears.

- 5 Do the following, and then click **Save**:

- Select **Left** or **Right**.
- Select a tag from the list.
- (Optional) Enter a comment.

The measurement is saved and the plaque value appears in the Saved Results area.

Up to 8 measurements may be saved for each patient exam.

Repeat these steps until all measurements are performed.

Use the R key to review the next image and the SHIFT+R keys to review the previous image.

Measurement Results

IMT and plaque measurements can be saved into a collection of measurements displayed in the Saved Results area. These individual values as well as average values are included on the IMT report. Selected measurements can be regenerated, edited, and deleted. Measurements imported from NanoMaxx, M-Turbo, or MicroMaxx ultrasound systems can only be excluded or included in the report.

A summary of all saved results can be viewed on the Summary tab.

Selecting Saved Measurements

Select Measurements

- ❖ Do any of the following:
 - Click to select a single measurement.
 - Right-click to select a single measurement and display a pop-up menu with commands to Regenerate, Edit, or Delete the saved measurement.
 - SHIFT-click to select measurements in consecutive order.
 - CTRL-click to select measurements that are not in consecutive order.

Regenerating Measurements

When there is at least one saved measurement, that saved measurement together with the associated image can be regenerated and displayed.

The Regenerate command can be used:

- To redisplay any saved measurement after the image has been cleared.
- To view individual measurements that have been opened from a previously saved measurement file.
- When a measurement is regenerated and edited, a new individual measurement is created.

Regenerate Measurement

- 1 From the Saved Results area, select the measurement.
- 2 Click **Regenerate**, or right-click and select **Regenerate** from the pop-up menu.

The image containing the measurement appears.

If the image cannot be located, a dialog box appears indicating the patient name and original location of the image.

Deleting Saved Measurements

Use Delete to remove a saved measurement from a patient exam.

Delete Measurement

- 1 From the Saved Results area, select the measurement.
- 2 Click **Delete**, or right-click and select **Delete** from the pop-up menu.

The measurement is deleted, and the remaining saved measurements are renumbered.

Excluding Imported Measurements

You can exclude a saved imported measurement to keep it from being included in a patient report. Excluding a measurement does not remove it from the exam, just from the report.

By default, all measurements are included in the report. If you select to exclude a measurement from a report, it is not deleted from the results and can be reselected to include in another report. Look for an asterisk or view the print preview to verify which imported measurements are included in a report.

Exclude Measurement

- 1 From the Imported Results area on the Imported tab, select the measurement.
- 2 Click **Exclude from Exam**.

The asterisk is removed from the measurement indicating that it is not included with other measurements in the patient report.

Only imported measurements with asterisks are included in the patient report.

Include Measurement

- 1 From the Imported Results area on the Imported tab, select the measurement.
- 2 Click **Include in Exam**.

The asterisk is replaced next to the measurement indicating that it will be included with other measurements in the patient report.

Only imported measurements with asterisks are included in the patient report.

Editing Measurements

The only portions of a saved measurement that can be edited are comments and location tags.

Edit Measurement

- 1 From the Saved Results area, select the desired measurement.
- 2 Click **Edit**, or right-click and select **Edit Saved Measurement Info** from the pop-up menu.

- The Saved Measurement Tag dialog box appears.
- 3 Enter or edit comment information or location tag.
 - 4 Click **OK**.

Reviewing Saved Exams

Review Saved Measurements

- 1 From the **File** menu, select **Open Saved Exams**.

The Open Saved Exam dialog box appears listing the existing patients.

Groups of saved measurements are listed and identified as Measures.kpt or Measures.xml.

If a previous file has been reviewed and other measurements are performed, each modified exam is stored in a new file with a new file name, for example, Measures1.kpt, Measures2.xml.

- 2 Select the desired file.

The patient information and all saved measurements for this patient exam are opened and replace the current patient.

The first measurement, 1 in the # list, is automatically regenerated and displayed on the active image, if available.

If any of these saved measurements are deleted or new measurements are added, a new file is generated for this exam. The original file remains intact.

To regenerate other saved measurements for this file, see [“Regenerating Measurements” on page 30](#).

- 3 Click **OK**.

Manual Calipers

Manual Calipers allow you to make six linear distance measurements on an image. The results are displayed in the corresponding dialog box.

Use Manual Caliper

- 1 Open a patient image.
- 2 Press the M key to initiate the caliper measurement mode.
- 3 Click in the Active View pane to place the first measurement point.

The distance from the first point to the cursor position appears in the status bar at the bottom of SonoCalc IMT, for example, “Caliper Dist=##.### mm.”

The x and y values are in pixels.

- 4 Click in the Active View pane to place the second measurement point.

The distance between the two points appears in the Caliper Measurements dialog box.

A number appears next to the measurement, indicating the corresponding measurement results.

To clear all distance measurements, press the ESC key.

- 5 Select the next caliper in the Caliper Measurements dialog box and repeat these steps, as needed.
- 6 Click **OK** to close the Caliper Measurements dialog box.

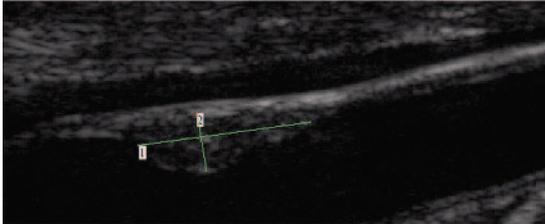


Figure 13 Two Distance Measurements

IMT Report

The IMT report provides the average CCA Mean IMT and average CCA Max Region IMT, displays an image of the patient's carotid artery, displays the patient's placement as a percentile of the population, and plots the patient's average IMT value against the population you specify.

The IMT image and measurement on the first page of the report are the current image and measurement on the screen at the time you create the report. Subsequent pages display Individual IMT measurements, average plaque measurements, and measurements transferred from NanoMaxx, M-Turbo, or MicroMaxx ultrasound systems.

Customizing Report Stationery

By default, the report has a SonoSite logo at the top. You can instead use a custom logo.

Use a Custom Logo in Reports

- 1 Prepare the logo per these guidelines:
 - BMP format
 - 350 by 100 pixels
 - 24-bit color
 - Filename **LocationImage_350x100.bmp**
- 2 Save the file in the \SonoCalc\ExamData\IMT Tables folder.
- 3 Restart SonoCalc IMT.

Viewing IMT Report

The IMT report displays the last active image. To select another image for the report, regenerate the desired image to make it the active image.

View Report

- ❖ From the **File** menu, select **Print** or **Print Preview**.
The IMT report appears.

Saving Report as PDF

Save Report as PDF

- 1 On the Summary tab, click **Save as**, or from the **File** menu, select **Save As PDF**. The Save As dialog box appears.
- 2 Verify the file location and patient name.
- 3 Click **Save**.

Printing Report

Print Report

- 1 Ensure that there is at least one saved IMT measurement in the Saved Results area.
- 2 From the **File** menu, select **Print**.
- 3 Verify settings and the printer location.
- 4 Click **OK**.

Individual and imported measurements can be included in a report if there are imported measurements available for a patient. Both individual measurements completed in SonoCalc IMT and imported measurements show on the report and are included in the averages.

Print Report with Imported Data

- 1 Select the Imported tab.
- 2 Exclude any measurements that you don't want to appear in the report. See [“Excluding Imported Measurements” on page 31](#).

The asterisk is removed from the measurement.

Note: The default is for all imported measurements to appear in the report. An asterisk indicates that the measurement will appear in the report. If a measurement is selected for exclusion from the report, the asterisk is removed.

- 3 From the **File** menu, select **Print**.

If you want to preview the report before printing, click **Print Preview**.

Note: Excluded measurements can still be included in future reports. See “[Excluding Imported Measurements](#)” on page 31.

Graph Setup

The report contains up to two graphs. The IMT graph tables list the population data used to plot the graphs. You can use the default IMT graph tables, or you can set up custom IMT graph tables. The values in the default IMT graph tables are from the research listed in “[References](#)” on page 37.

After tables are set up, you select them on the Report Configuration tab. See “[Report Configuration Tab](#)” on page 6.

View the Default IMT Graph Tables

- 1 From the **Settings** list, select **Plot Settings**.

The IMT Graph Tables dialog box appears.

- 2 From the **Graph Title** list, select a table to view:

- Average CCA Mean IMT Compared to Male Population
- Average CCA Mean IMT Compared to Female Population
- Average CCA Max Region IMT Compared to Male Population
- Average CCA Max Region IMT Compared to Female Population

These tables display data in two decimal points regardless of the source reference data and cannot be changed or edited.

Custom IMT Graph Tables

You can set up as many as 100 custom IMT graph tables to use comparative population data not available in the default IMT graph tables. You can customize age, population percentile, and IMT measurement value.

WARNING: Prior to use, verify that custom table data entries are correct. SonoSite recommends previewing the report before using for an exam.

Set Up Custom IMT Graph Table

- 1 Close all exams and images.
 - 2 From the **Settings** menu, select **Plot Settings**.
The IMT Graph Tables dialog box appears.
 - 3 Click **New Table**.
The IMT Graph Tables dialog box appears.
 - 4 Enter a title in the **Graph Title** field.
 - 5 Under **Gender**, select an option.
-

- 6 In the **Years** column, enter the ages, in consecutive order.
- 7 Modify the percentile column heads, if desired.
- 8 Enter IMT data in the appropriate fields.

Data must be in the allowable range between .2 and 1.400 mm.

- 9 Click **Save**.
- 10 Click **OK**.

Edit or Delete Custom IMT Graph Table

- 1 From the **Settings** menu, select **Plot Settings**.
The IMT Graph Tables dialog box appears.
- 2 In the **Graph Title** list, select the custom graph table to edit (default graph tables are not selectable).
- 3 Do one of the following:
 - Click **Edit**, enter edits, and then click **Save**.
 - Click **Delete**, and then click **Yes** to confirm.
- 4 Click **OK**.

Exporting Data

You can export data as text or as a measurement synopsis file.

Exporting as text allows you to save the patient information and measurement data as a text file.

Exporting a measurement synopsis file archives all patient exams and measurement data in a HIPAA compliant manner (removing patient names) to a single file. You must have saved patient data to export measurements to a synopsis file.

Export as Text

- 1 Select the file with the saved measurements you want to export.
- 2 From the **File** menu, select **Export as Text**.
- 3 Enter a file name.
- 4 Select a file location.
- 5 Click **Save**.

The measurements are saved as a text file.

Export Measurement Synopsis File

- 1 From the **File** menu, select **Export Measurement Synopsis**.
- 2 Enter a file name.
- 3 Select a file location.
- 4 Click **Save**.

The measurements are saved in SYN format (a custom text format).

Results Summary

Statistical information for measurements appears in the Summary Results area on the Summary tab. Summary statistics are provided for Mean IMT, Max Region IMT, and Plaque. They include the following:

| | |
|---------|--|
| Average | The average of all saved measurements |
| Min | The smallest IMT measurement in the saved measurement list |
| Max | The largest IMT measurement in the saved measurement list |

References

Amin Aminbakhsh, MD, G.B. John Mancini, MD. "Carotid Intima-Media Thickness Measurements: What Defines an Abnormality? A Systematic Review," *Clinical and Investigative Medicine*, August 1999, 22(4):149-157.

Table 1: ARIC Study:

Measurement Type: Average CCA Mean IMT over default measurement region width

Age Range: 45 to 65

Mean and 75th percentile

Table 1 and 3: CHS Study:

Measurement Type: Average CCA Maximum Region IMT over 1 mm segment

Age Range: 65 to 85

Mean and Standard Deviation

Oren, Anath, MD, et al. "Cardiovascular Risk Factors and Increased Carotid Intima-Media Thickness in Healthy Young Adults, The Atherosclerosis Risk in Young Adults (ARYA) Study," *Archives of Internal Medicine*, (2003), 163:1787-1792.

Measurement Type: Average CCA Mean IMT over default measurement region width

Mean Age: 28

Mean and Standard Deviation

Tonstad, Serena, et al. "Risk Factors Related to Carotid Intima-Media Thickness and Plaque in Children With Familial Hypercholesterolemia and Control Subjects," *Arteriosclerosis Thrombosis, and Vascular Biology*, (1996), 16(8):984-991.

Measurement Type: Average CCA Mean IMT over default measurement region width

Mean Age: 14

Mean and Standard Deviation

Measurement Type: Average CCA Maximum Region IMT over 1 mm segment

Mean Age: 14

Mean and Standard Deviation

Tonstad, Serena, et al. "Carotid Intima-Media Thickness and Plaque in Patients with Familial Hypercholesterolaemia and Control Subjects," *European Journal Clinical Investigation*, (1998), 28(12):971-979.

Measurement Type: Average CCA Mean IMT over default measurement region width

Mean Age: 38

Mean and Standard Deviation

Measurement Type: Average CCA Maximum Region IMT over 1 mm segment

Mean Age: 38

Mean and Standard Deviation

Urbina, Elaine M. "Impact of Multiple Coronary Risk Factors on the Intima-Media Thickness of Different Segments of Carotid Artery in Healthy Young Adults (The Bogalusa Heart Study)," *American Journal of Cardiology*, (2002), 90(9):953-958.

Measurement Type: Average CCA Max Region IMT over default measurement region width

Mean Age: 32

Mean and Standard Deviation

Additional Supporting References

Howard G, Sharrett AR, Heiss G, Evans GW, Chambless LE, Riley WA, et al. "Carotid Artery Intimal-Medial Thickness Distribution in General Populations As Evaluated by B-Mode Ultrasound." ARIC Investigators. Atherosclerosis Risk in Communities. *Stroke*, (1993), 24:1297-1304.

O'Leary DH, Polak JF, Krommal RA, et al. "Distribution and Correlates of Sonographically Detected Carotid Artery Disease in the Cardiovascular Health Study." CHS Collaborative Research Group. *Stroke*, (1992), 23:1752-1760.

O'Leary, DH, Polak JF, Krommal RA, et al. "Thickening of the Carotid Wall. A Marker for Atherosclerosis in the Elderly?," Cardiovascular Health Study Collaborative Research Group. *Stroke*, (1996), 27:224-231.

Polak JF, Krommal RA, Tell GS, O'Leary DH, et al. "Compensatory Increase in the Carotid Artery Diameter. Relation to Blood Pressure and Artery IMT in Older Adults", *Stroke*, (1996), 27:2012-2115.

Distance Measurement Accuracy

The SonoCalc IMT scaling factor error on auto-calibrated images is less than 1%. The scaling factor error on manually calibrated images depends on the user's ability to accurately place the calibration cursors. This error is in addition to the inherent errors of the imported image.

Technical Support

For technical support or to obtain additional license keys, contact SonoSite Technical Support as follows:

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|---------|--|
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