GLANDS

29 Thyroid Size

29.1 General

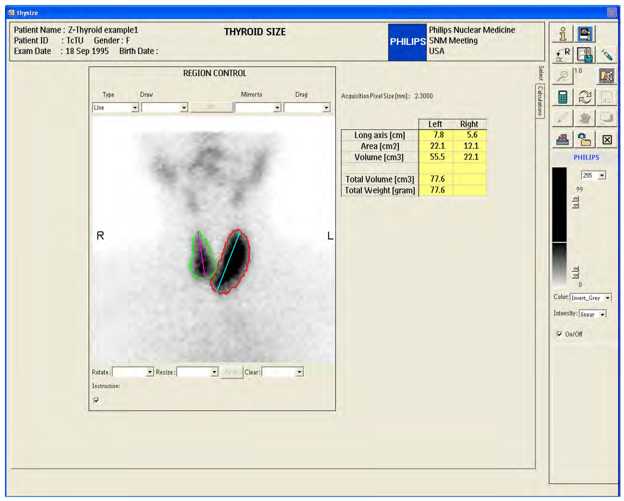


Figure 270 Thyroid Size application

This application contains a mode to measure up to four lengths and three methods to calculate the volume and estimated weight of the thyroid gland:

- Two cylinder method: each cylinder is determined from height and diameter
- Area x Height method: of each lobe
- Total Area to Cube method:

Each of these methods is described in this chapter.

29.2 Acquisition

Any static rectangular image is allowed, e.g., 256 x 256 or 512 x 512.

29.3 Processing

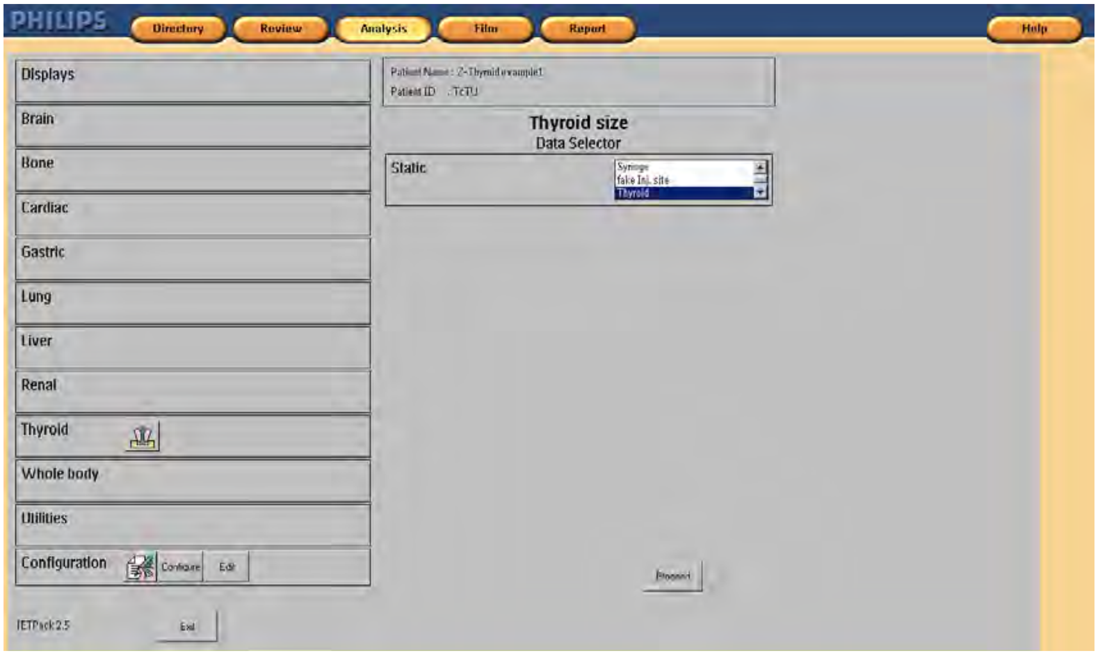


Figure 271 ISP JETPack panel, Thyroid Size application selected

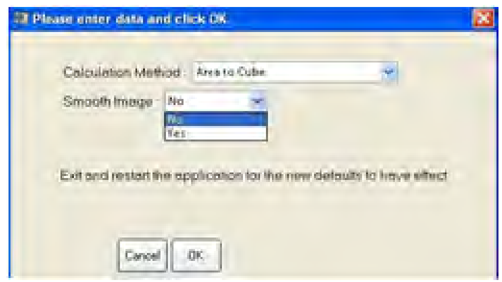
If required adjust the selected file in the data bucket and click **Proceed**.

29.4 Button Panel and Region Control

See Chapter 1, “Getting Started.”

29.5 Default Selection

Set Defaults: Click this button to bring up the default selection panel for the calculation method.



Select one of the methods and then click **OK** to store the default method.

Important You must exit the application and then restart to activate the new method.

29.6 Four Lengths Method

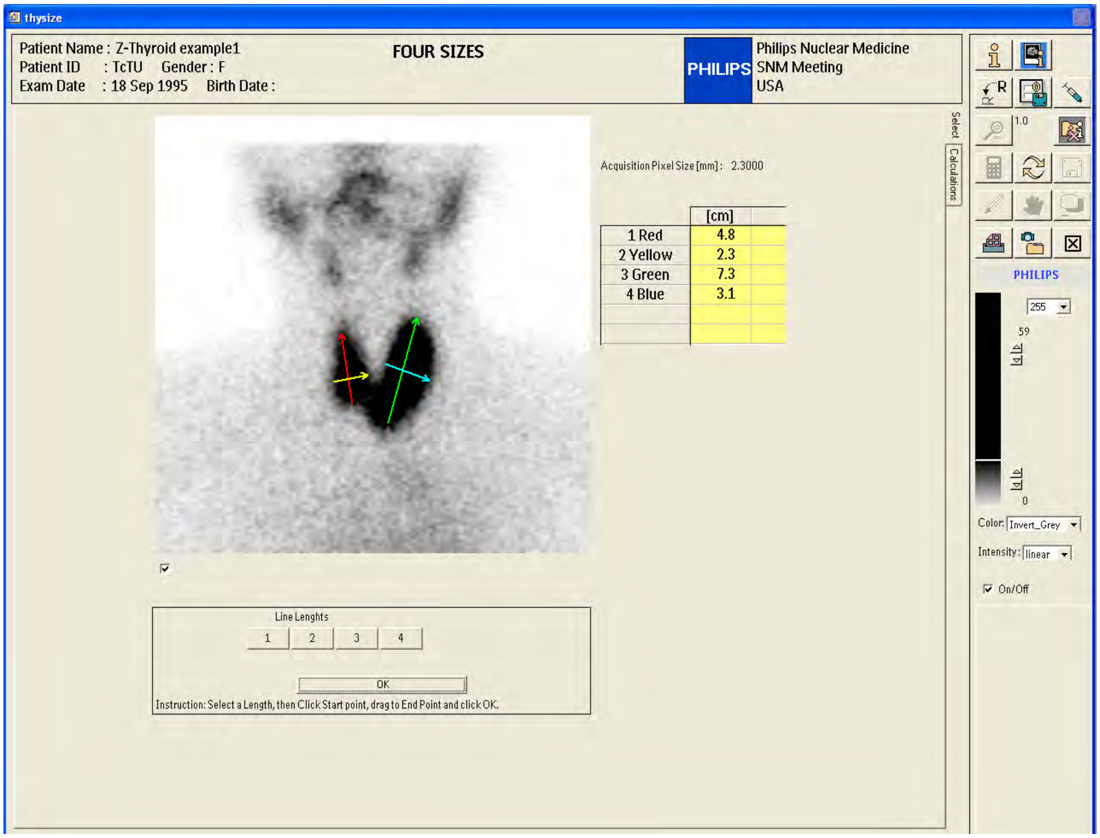


Figure 272 Four Lengths window

The selection panel has controls to start drawing each axis. When you select an axis, the buttons are grayed out until you have finished drawing and clicked **OK**.

To draw an axis, click and drag in the viewport from the desired start point to the end point. When you release the mouse button, the axis is drawn, but by clicking again you can draw a different axis. The axis is accepted only after you click **OK**. The axis may be redrawn by selection of the same pushbutton.

29.7 Two Cylinder Method

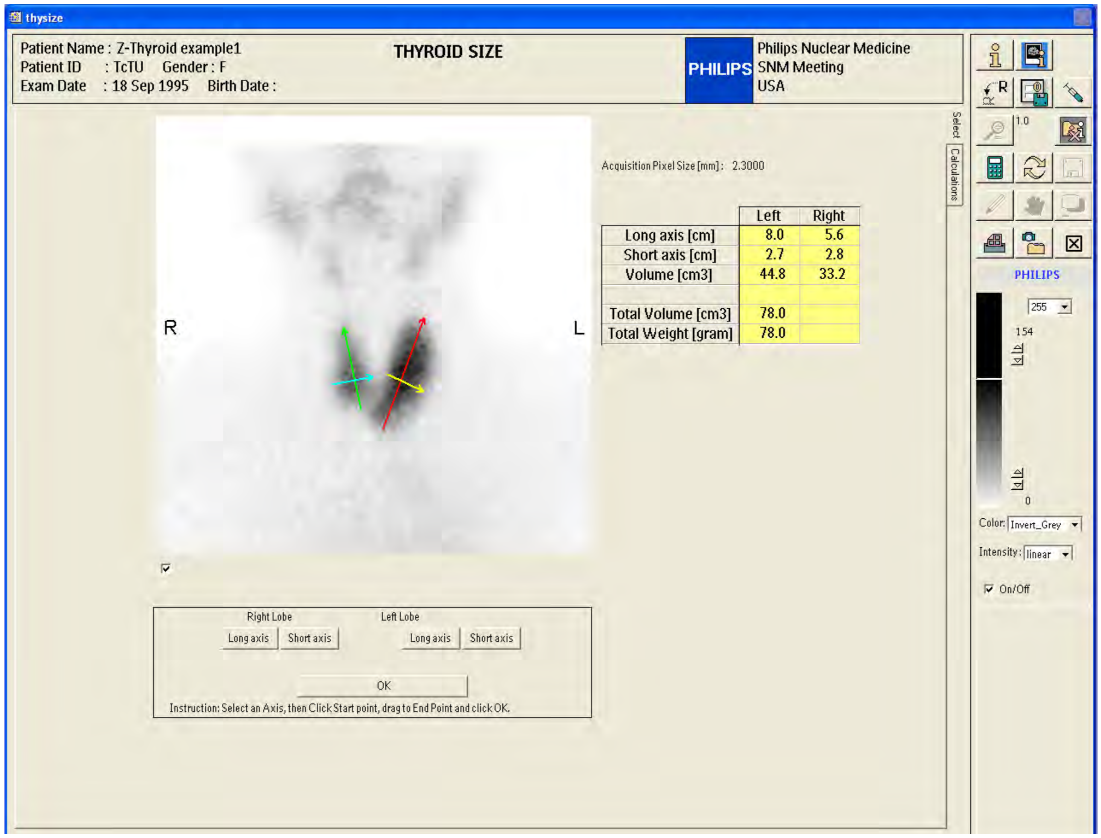


Figure 273 Two cylinder method screen

Draw the long and short axis of each lobe and then click the Calculate button to calculate the lengths, volumes and the estimated weight.

29.8 Area x Height Method

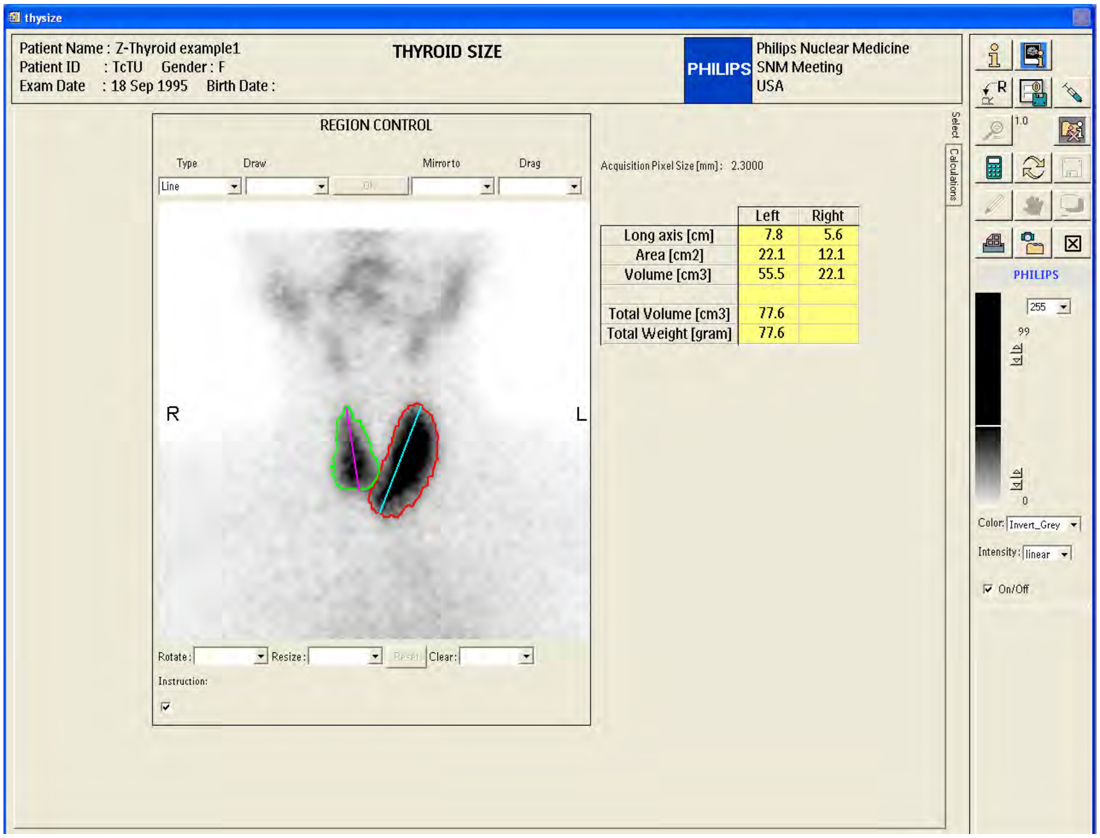


Figure 274 Area x Height screen

Draw the left and right area regions by the Polygon, Freehand, or Isofree method, and then draw the left and right lobe height line regions.

After you complete all four regions, click Calculate & Display to perform the calculation of the long axis, area, and volume of the left and right lobes. The total volume of the thyroid is obtained by adding the volumes of the left and right lobes. The actual thyroid volume is estimated by multiplying the calculated volume by a constant. Thyroid volume = 0.323 x Calculated volume. The weight and volume of Thyroid are considered to be the same as 1 cm3 = 1 gram, the same as water. Therefore

Weight = 0.326 x Calculated Volume [gram]
Thyroid Volume = 0.326 x Calculated Volume [cm3]

29.9 Area to Cube Method

Figure 275 Select Screen for the Area to Cube method

Draw a single thyroid region using the Polygon, Freehand, or IsoFree type region and then click Calculate & Display to generate the area, volume and estimated weight results.

The volume of the total thyroid is estimated by calculation of the area of the region of interest in cm2 as above, then multiplication of the area by the square root of the area:

V =(SquareRoot (Area)) x Area

The actual thyroid volume is estimated by multiplying the calculated volume (V)by a constant.

Thyroid volume = 0.326 x V

The weight and volume of Thyroid are considered to be the same as 1 cm3 = 1 gram, the same as water. Therefore

Weight = 0.326 x V [gram]
Thyroid Volume = 0.326 x V [cm3]

This method was proposed by Standke, e.a., in 1983.

29.10 Calculations Page

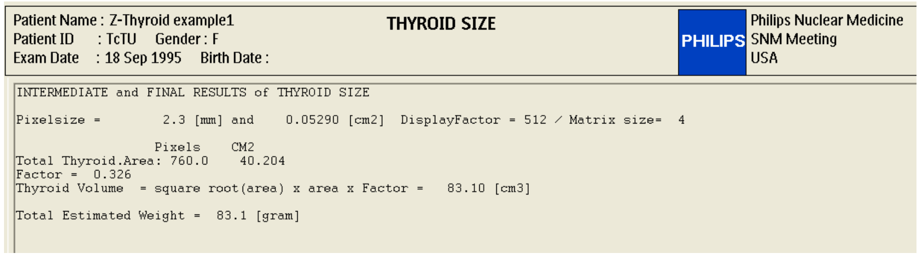


Figure 276 Calculations page

The Calculations page shows intermediate and final results of the calculations internal to the application. The results presented here allow for an easy verification of the program outcome.

29.11 Calculations

Method 1: Two Cylinders:

The length of each axis is determined by multiplication of the length in pixels by the size of a pixel in mm.

The volume of each lobe is estimated by calculating the volume of the cylinder that is the defined surface of the circle times the height of the cylinder.

The surface of the circle = ¼ x pi * ShortAxis^2 ; the height = the length of the long axis.

The weight is estimated by multiplying the volume by a constant.

Weight = 1.0 x Volume [grams]

Method 2: Area x Height:

The volume of each lobe is estimated by multiplication of the area of a lobe in cm^2 times the long axis in cm.

The area of a lobe is calculated by converting the number of pixels in the user drawn region to cm^2. The total volume of the thyroid is obtained by adding the volumes of the left and right lobes. The The Thyroid volume is estimated by multiplying this volume by a constant.

Thyroid volume = 0.323 x Volume [cm3]

It is assumed that 1cm3 = 1 gram therefore the Thyroid weight is the same resulting value in grams.

Weight = 0.323 x Volume [grams]

Method 3: Area to Cube:

The volume of the total thyroid is estimated by calculation of the area of the region of interest in cm^2 as above, then multiplication of the area by the square root of the area:

V =(SquareRoot (Area)) x Area.

Then the Thyroid volume is estimated from V by multiplication with a factor.

Thyroid volume = 0.3.26 x V

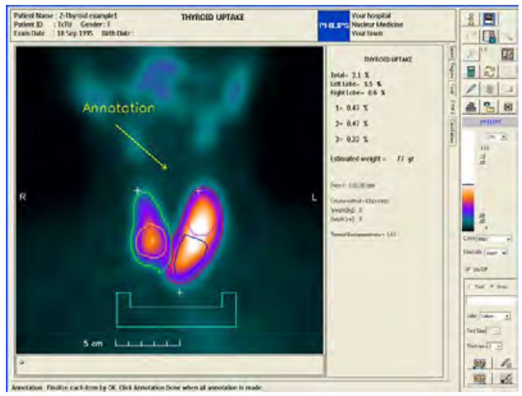
It is assumed that 1 cm3 = 1 gram therefore the Thyroid weight is the same resulting value in grams.This method was proposed by Standke, e.a., in 1983.

29.12 Reference

"Globale und regionale Computer Funktionstopografie der Schilddrüsse", R. Standke e.a Nucl.-Med. Band XXII/Heft 6, 1983

30 Thyroid Uptake

30.1 General



The application allows calculation of Thyroid uptake from a Thyroid image and applied activity as obtained from Capsule or Syringe input data or images. Uptake of the applied activity can be calculated from Pre injection, Post Injection and Injection site images. Activity is corrected for decay. The time of application and thyroid measurement can stretch over multiple days.

The volume calculation can be based on three different methods;Area x height, Area to Cube or Ellipsoids. In total the application handles 48 different scenarios concerning images, input panels and volume calculation methods,

30.2 Acquisition

Any Static rectangular image is allowed, e.g. 256by or 128by.

All acquisition durations of the various images are normalized to counts per minute during the calculations. Therefore the duration of acquisition of the various images may vary.

The following images may be selected;

- Thyroid image, Anterior, required
- Marker image, Anterior, (optional)
- Pre-Injection syringe or Capsule image (optional), if not selected the activity data must be entered via an input panel.
- Post-Injection image (optional)
- Injection site image (optional)

You must set the Defaults, as described later, for the application to allow processing the images or to use data from an input panel.

30.3 Processing

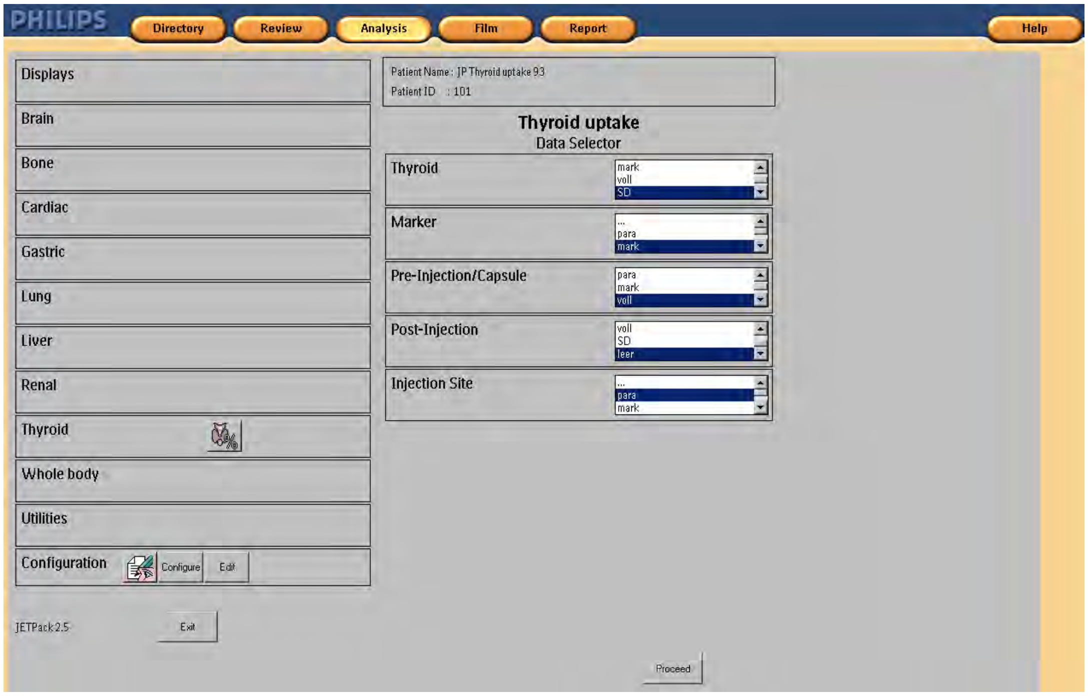


Figure 277 ISP JETPack panel, Thyroid uptake application selected

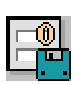
If required adjust the selected file in the data bucket and click **Proceed**.

30.4 Select Page

Figure 278 Select page with the selected images displayed.

This page gives you an overview of the selected images and you can still change the method of volume calculation and the number of regions for the thyroid uptake calculation at the left bottom side of the screen. In the lower center of the screen the time of application of the activity (capsule or syringe injection) can be entered for calculation of the time lapse p.o or p.i of the thyroid acquisition. The calculation can cover multiple days and can be enabled via the Defaults setting.

30.5 Button Panel and Region Control



See the General description for an explanation of the various buttons.

Set Defaults: Click this button to bring up the panel below:

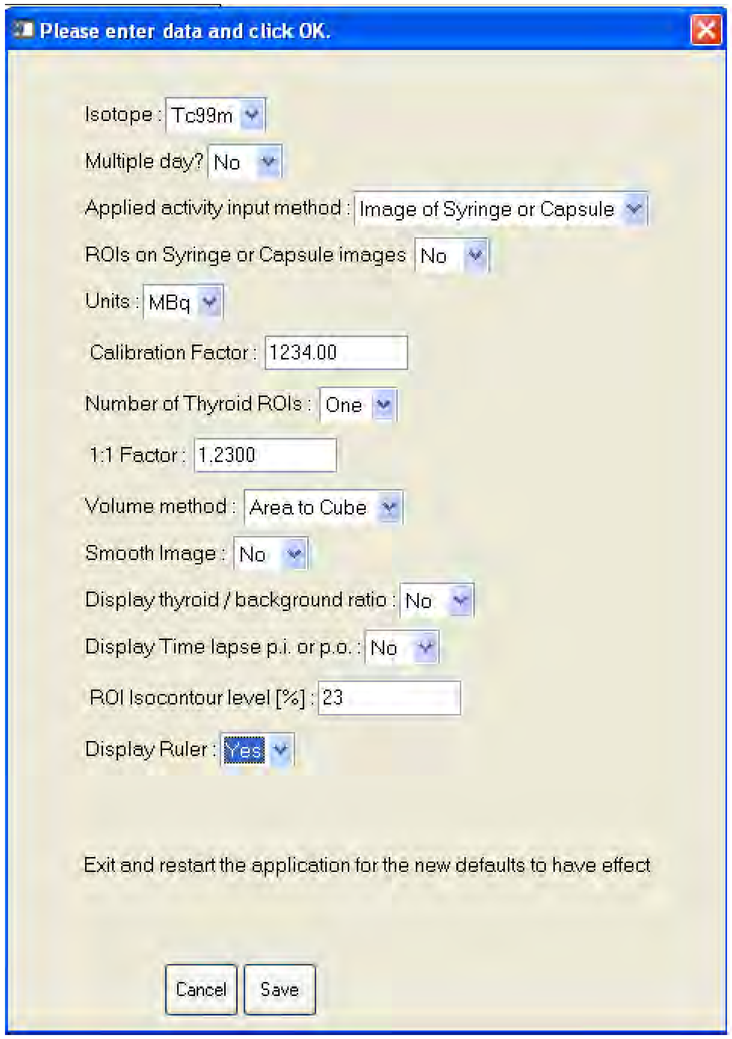


Figure 279 Default entry and Current Defaults display.

The defaults that can be set are shown in Figure 279, when this panel is launched it shows the current defaults. For new defaults to be effective after clicking OK you must exit and restart the application.

Isotope: Tc-99m, I-123 or I-131 for different automatic decay corrections.

Multiple Day: set this to yes when you use an isotope like I-131 and apply the activity one or more days before acquiring the thyroid image. This is only needed when you use the data entry panel for syringe or capsule (Syringe images = no). For images the time lapse over multiple days is automatically calculated.

30.5.1 Applied activity input method

Syringe Panel

Activity of the full and empty syringe as determined elsewhere, times of measurement, as well as the dose calibration factor is entered in a panel. See Figure 280.

Image of Syringe or Capsule

Activity is determined from images of the full syringe, optional empty syringe and optional Injection site or from an image of the Capsule.

Capsule panel

Activity of the capsule, time of measurement and the dose calibration factor are entered in a panel. See Figure 281.

30.5.2 Regions on Syringe images

No, takes the counts in the full image matrix.

Yes, requires you to draw a region on all selected syringe images, Pre and Post if available.

Units: MBq, cpm or MCi. This selection is only relevant if you use the data entry panel for syringe or capsule activity.

Calibration factor: The applied activity entered on the data entry panel is multiplied by this factor. You have to determine this factor from the way you measure and enter the activity in either MBq ,cpm or mCi. The activity in MBq , cpm or mCi, multiplied by the calibration factor must represent the counts per minute that the gamma camera sees when the activity to apply is placed in front of the collimator. If you enter the activity in cpm this factor should be 1.0

If you use MBq as units,the Calibration factor must indicate how many counts per minute are counted by the camera if 1 MBq is measured (cpm/MBq). In the same manner the factor would say the cpm if 1 mCi was measured and you enter the activity in mCi (cpm/mCi).

Number of Thyroid regions: One sets the region selection menu to one single thyroid region. Two, sets this menu to Left and Right lobe regions. Each menu has the possibility to select the background region and up to 3 nodal regions.

1:1 factor: This factor is used to change the size of the thyroid and 5 cm ruler image on the Final page such that when the screen is printed to hardcopy the sizes of the ruler and thyroid agree with the actual size. To determine this factor acquire a couple of images of a few point sources at exactly 10 cm apart and adjust the factor until the distance between the sources is 10 cm on the printout.

Volume method: None, Area to Height, Area to Cube or Ellipsoids. Determines the way the volume of the thyroid is estimated. For a description of each method see the section on Calculations.

The method can be overruled on the Select page (see Figure 278)

Smooth image: No, the Thyroid image is used throughout the application as it was acquired. Yes, performs 5 point smooth operation on the thyroid image beforehand.

Display Thyroid/Background ratio? If yes is selected the application displays on the Final page the ratio of the activity in the thyroid region over the activity in the area normalized background region.

Display time lapse p.i or p.o: If yes is selected the application expects that a valid clock time is entered on the Select page (see Figure 278). It then calculates the difference in hours and minutes between the entered clock time and the time of acquisition of the thyroid image. Multiple days is allowed and enabled if the “Multiple day” switch in the defaults is set to yes.

Isocontour ROI %: The value entered here presets the percentage of image maximum for the generation of an isocontour ROI. The actual value can be changed anytime by means of the mouse wheel. Display Ruler: Yes or No. With this selection the Ruler can be added to or left out of the images on the Final pages.

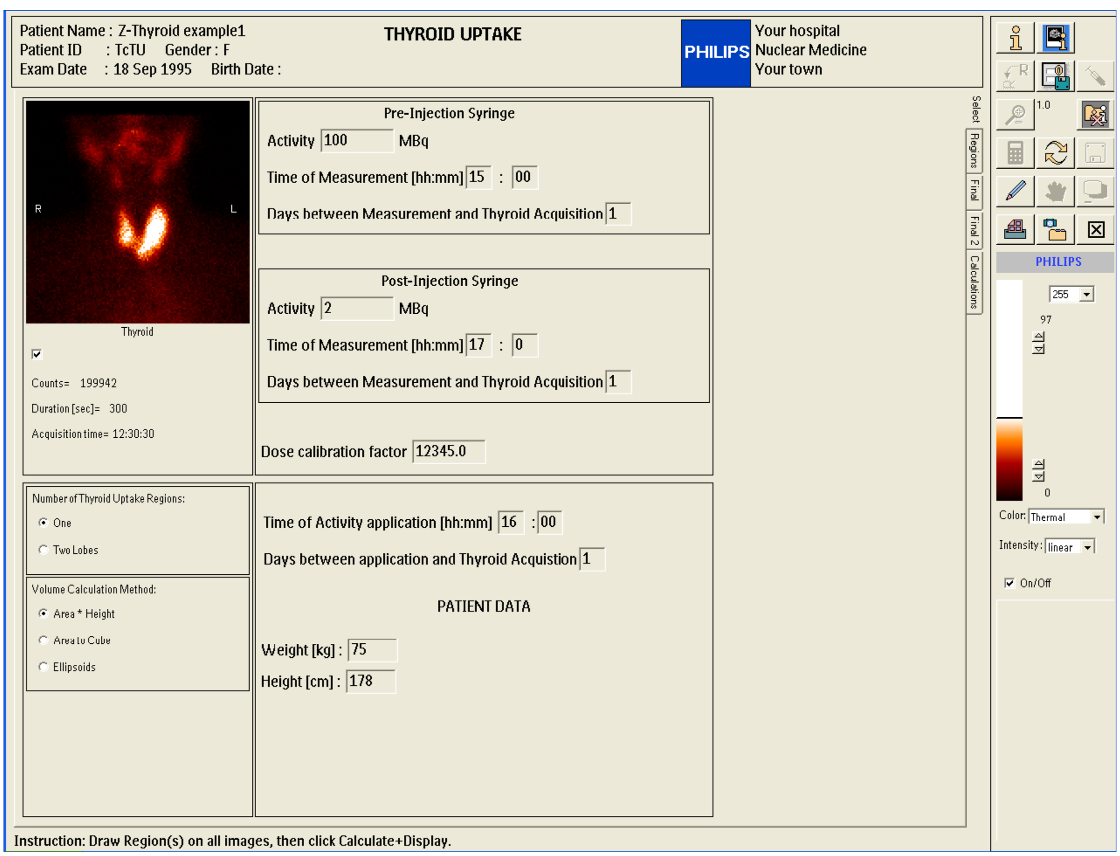


Figure 280 Example data entry panel for Syringe data.

For the situation in Figure 280 I selected in the Defaults panel Multiple days = yes, Applied activity input method = Syringe panel, and Display time lapse p.i or p.o = yes. The program will calculate the time lapses between Pre-Injection syringe to Thyroid acquisition, Pre-Injection syringe to Post-Injection syringe and Time of activity application to Thyroid acquisition and use these to calculate the proper decay corrections.

The time lapse, as calculated from time of activity application to thyroid acquisition, will be expressed in hours and minutes on the Final page.

Notice that the Number of Thyroid regions was preset to One lobes and the Volume calculation method to Area x Height. However both these selections can be changed “on the fly”.

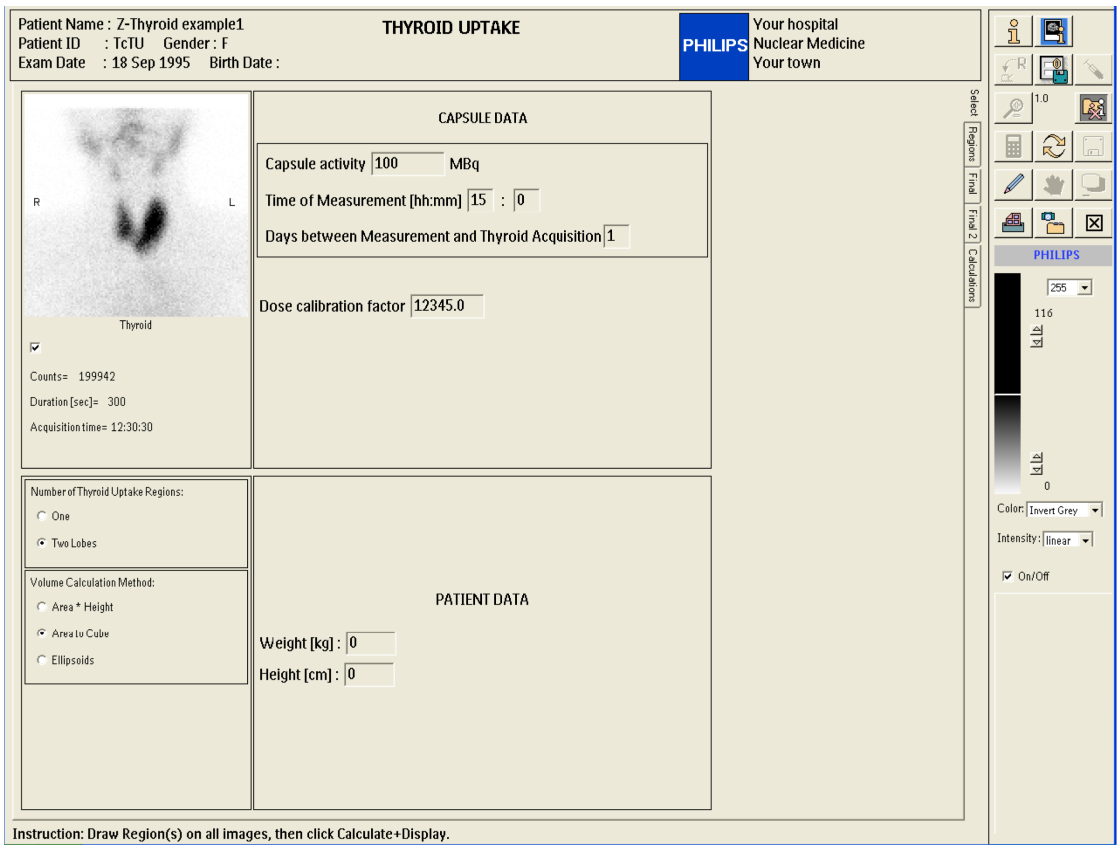


Figure 281 Example data entry panel for Capsule activity.

Here the Multiple days default was set to yes, applied activity input method to Capsule panel, dose calibration factor to 12345 and Display time p.i /p.o to no.

Be aware that if you want to measure Capsule activity through images that you must select Activity application = Syringe/Capsule image and Activity images = yes. In stead of Pre-syringe image you then select the capsule image from the database.

30.6 Regions Page

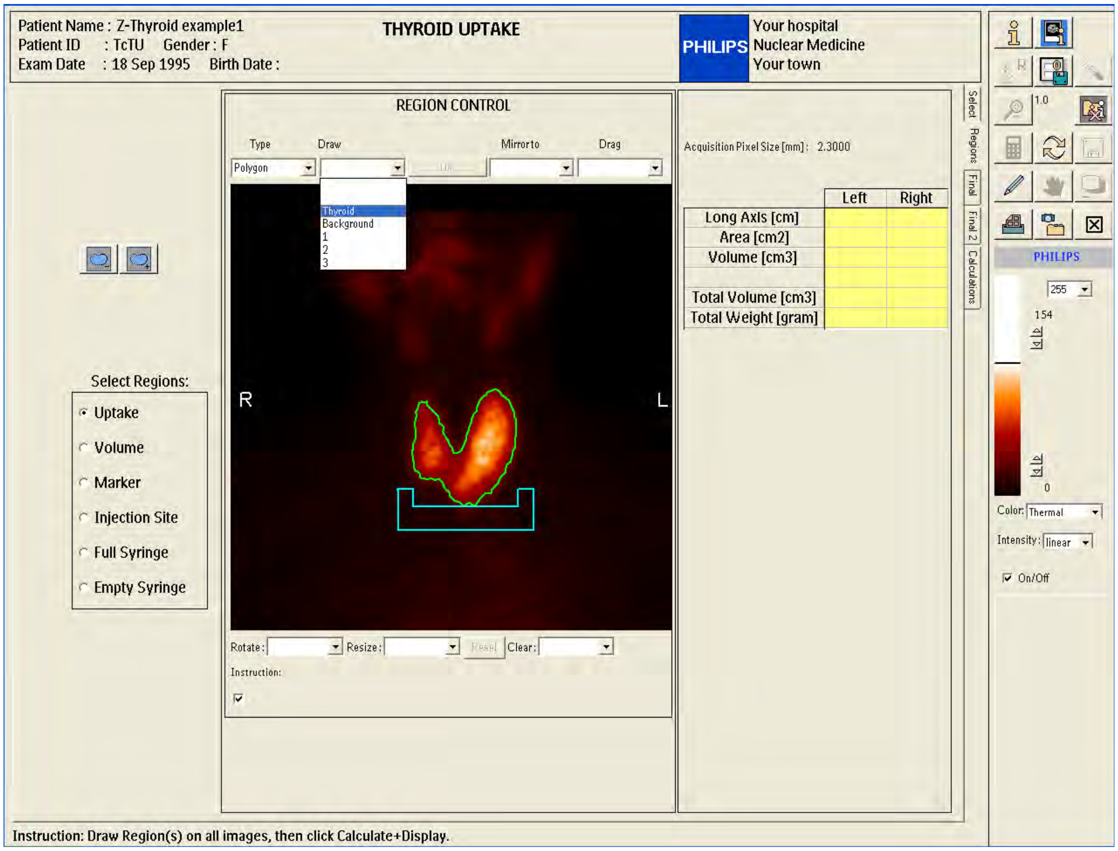


Figure 282 Regions page, Thyroid image selected for region drawing, notice the Automatic background region that is available from the Type menu.

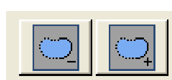


Figure 283 Click these buttons to smooth multiple times or unsmooth.

At the top left corner of this page two buttons allow you to smooth or unsmooth the Thyroid image multiple times. At the same time all thyroid images are smoothed, on the Regions, Final and Final2 pages. The smaller images are smoothed by a 5 point smooth, the large “One to One” images on both Final pages by a 9 point smooth.

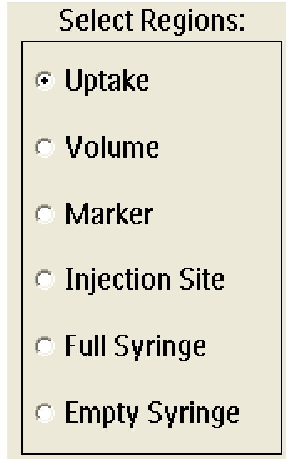


Figure 284 Regions selection on Regions page

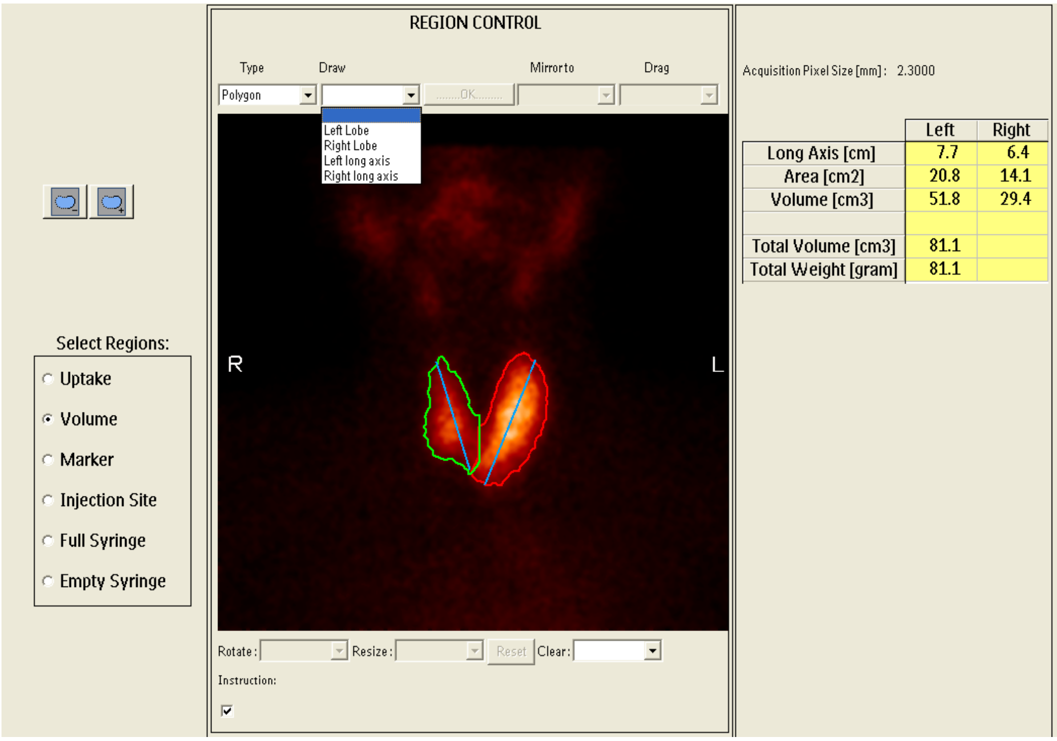
Depending on the selected input images and the volume calculation method the selection for images to be displayed in the Region control is configured.

In this extreme example the Defaults were set to Applied activity input method = Image of Syringe or Capsule and ROIs on of Syringe or Capsule Image = yes. Beside the thyroid image, a marker image, an Injection site image, Pre-Injection (full) and Post-injection image were selected. If the volume calculation method is Area x height or Ellipsoid also special regions must be draw on the thyroid image for these calculations. To set up the proper region menus for these volume calculations, the regions “Volume calculation method” must be selected on the “Select” page. In the case of the Area to Cube volume calculation method the Volume image selection is not shown as the thyroid region (one or two lobes) is used directly for the volume calculation.

Figure 285 Uptake regions only

In this case only the Thyroid image needs region drawing if Activity application= Syringe/Capsule image, Activity images= yes, Regions on images = no. No Marker image or “Injection site” images were selected, only Thyroid, Pre-injection and post injection syringe images. The volume calculation is selected as “Area to cube” method.

30.6.1 Volume: Area x Height method



	Left	Right
Long Axis [cm]	7.7	6.4
Area [cm2]	20.8	14.1
Volume [cm3]	51.8	29.4
Total Volume [cm3]	81.1	
Total Weight [gram]	81.1	

Figure 286 Volume method: Area x Height applied on the thyroid image.

The “Area x Height” volume calculation method requires you to draw the Left and Right lobe regions and the Left and Right long axis regions. In the case of the Two Lobes thyroid region mode the Left and Right lobe regions are automatically copied from the thyroid region set to the volume region set and you don’t need to draw them again. The Long axis regions for left and right lobe are in that case the only two regions to draw.

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30.6.2 Volume: Ellipsoids method

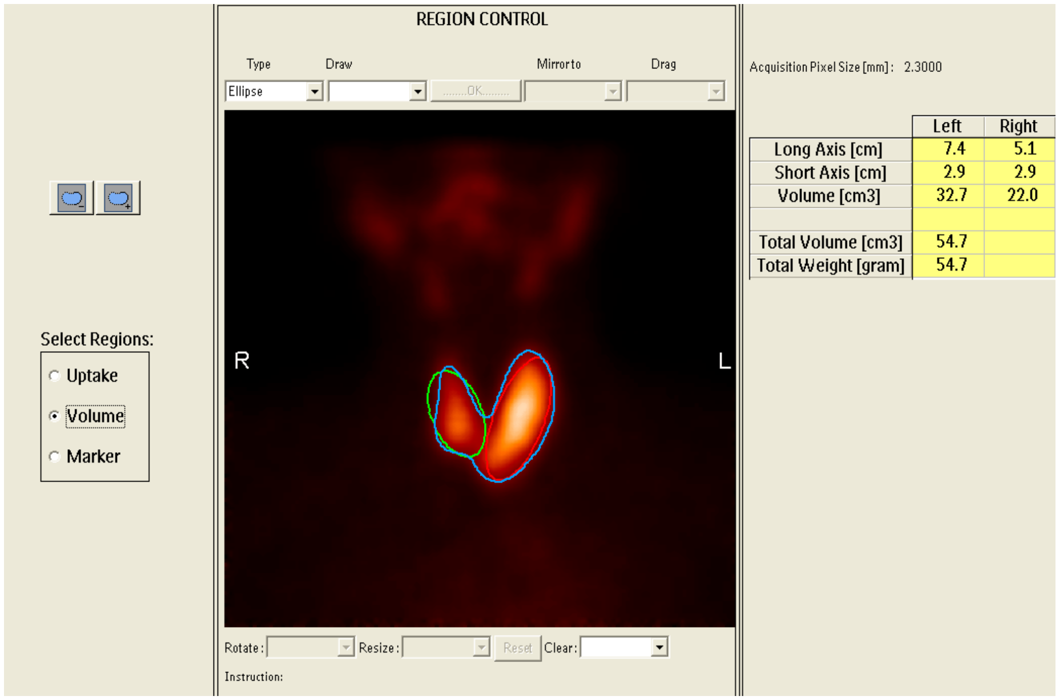

Figure 287 Volume method: Ellipsoids on Left and Right lobe applied on the thyroid image. Notice that the Thyroid reference region(s) are displayed in blue automatically.

The Ellipsoid method requires you to draw at least one ellipse region on either the left or right lobe. If you have two lobes on the screen both ellipses must be drawn to get the total volume calculated from both the left and the right lobe.

Reference ROIs

For reference the thyroid region(s), one region or the two lobe regions are displayed on the Volume image.

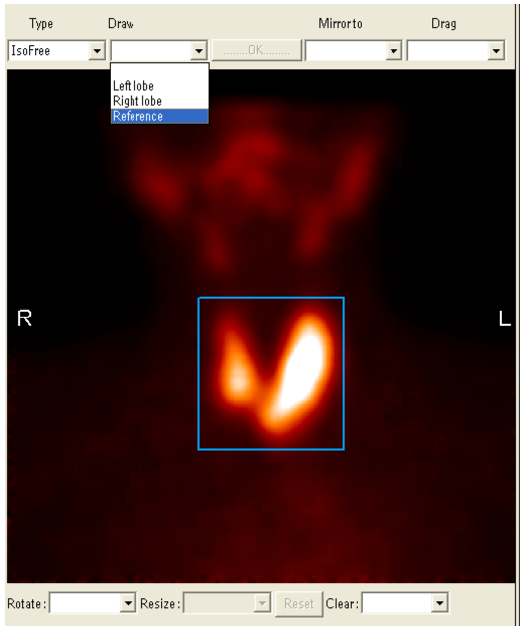

Figure 288 rectangular Thyroid uptake ROI

In the case that you selected a rectangular Thyroid uptake ROI that region will be displayed but it may not be appropriate as a reference region. You can redraw the Reference ROI as an Isocontour region anytime by selection of the Reference item in the Draw menu.

To draw an ellipse region first click to the determine the start point of the long axis, hold and drag the left mouse button to define the end point of the long axis, then continue to draw the short axis from start to end point. When both axis are drawn the ellipse is calculated and drawn automatically. You can redraw the long and short axis to change the ellipse. Only when you click on the OK button the ellipse drawing is captured as a region. The ellipse region can be rotated, dragged, mirrored and cleared but not resized as that would change the long and short axis dimensions.

Be aware that the three methods to estimate the volume of the thyroid all use an approach to the depth of the thyroid. Therefore the volume results of the three methods “Area x height”, “Area to cube” and the Ellipsoids can be quite different.

30.6.3 Markers

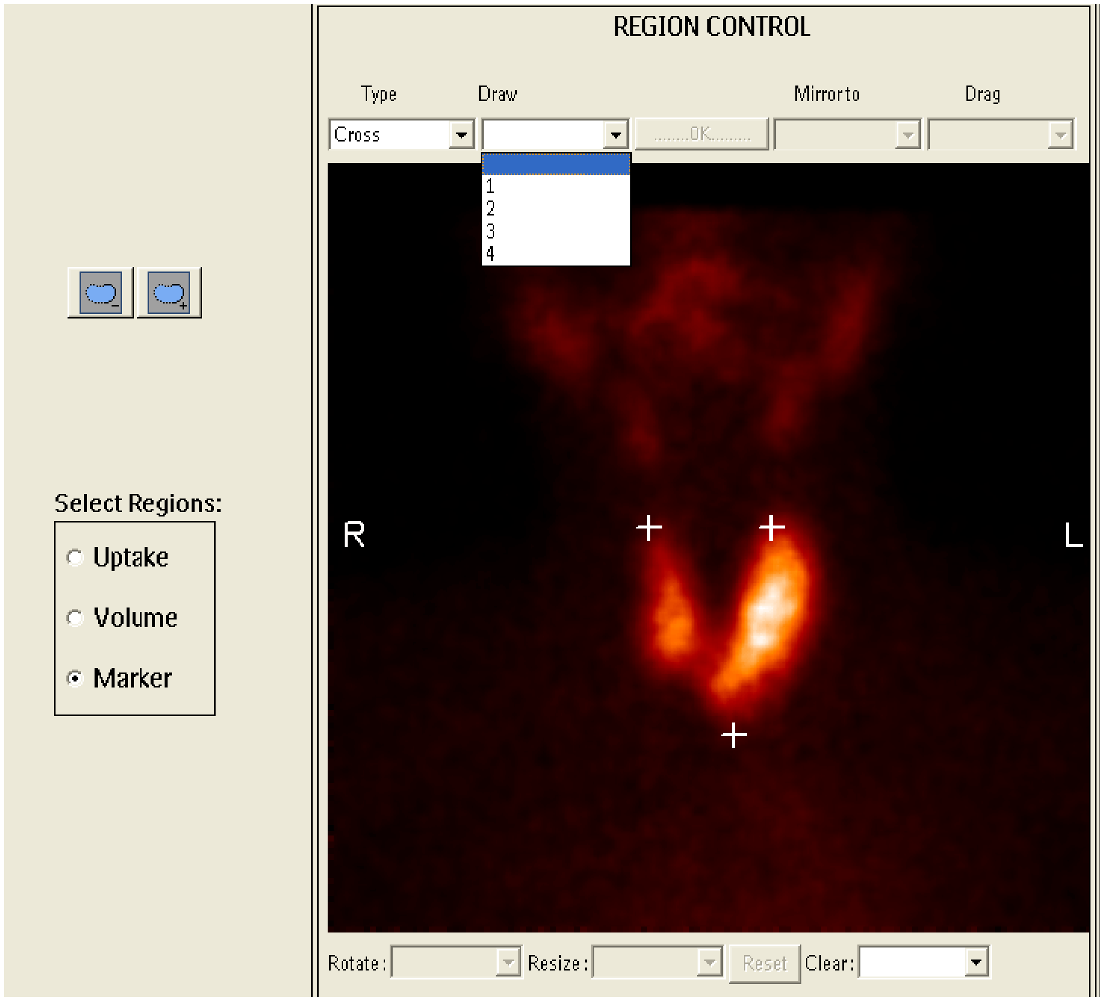

Figure 289 Example Marker image with 3 crosses marked.

For lack of a real example marker image the thyroid was selected again for Marker image. Up to four markers can be placed on the Marker image. The marker crosses are superimposed on the “one to one” image on the Final pages.

30.6.4 Injection site, Full Syringe and Empty syringe images

All these images require you to draw one region only in either polygon or freehand type.

30.7 Final Page

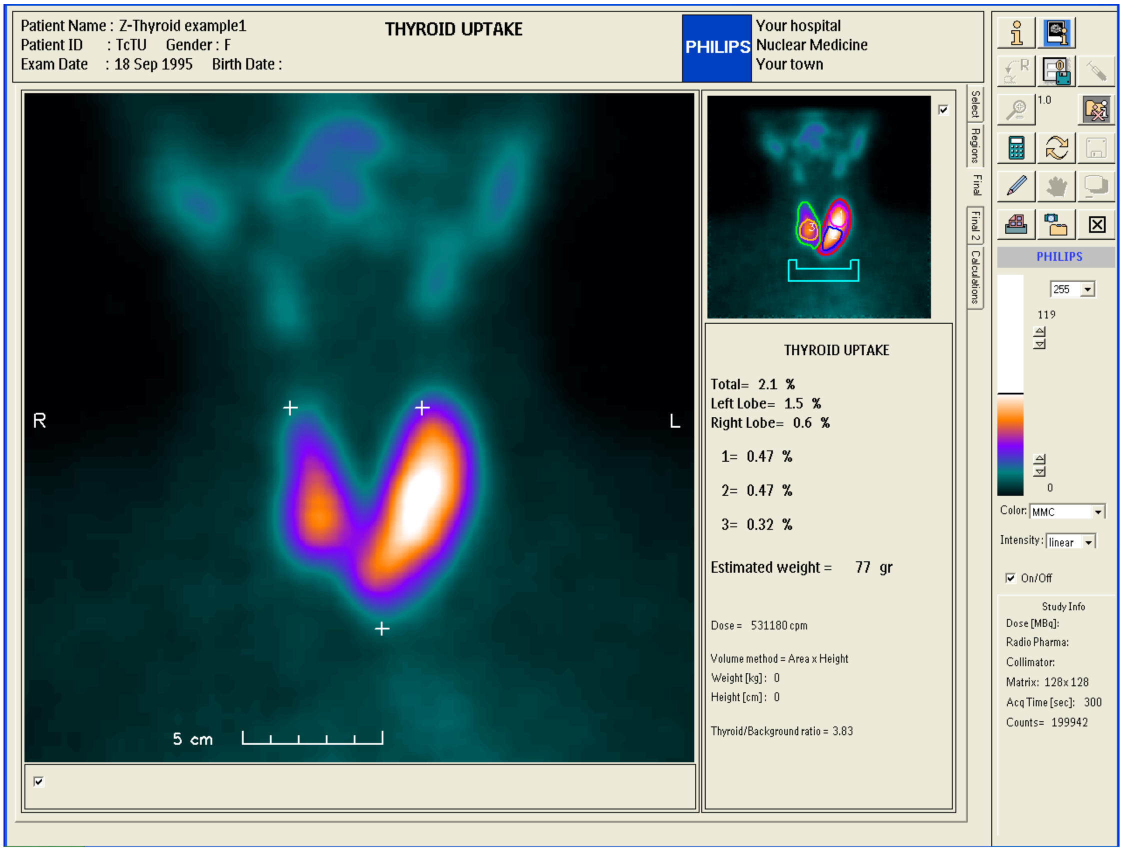

Figure 290 Final screen.

The final screen shows the “one to one“ image with a ruler and the three markers that were selected earlier.

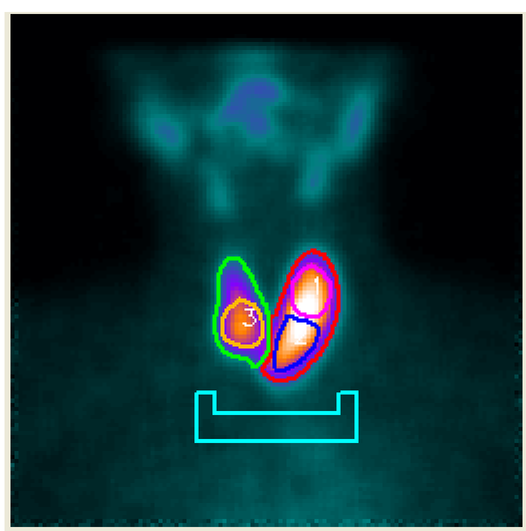

Figure 291 Regions image on Final page

In this example the left and right lobe regions of the thyroid were selected together with an automatic background region and three nodal regions labeled 1,2 and 3.

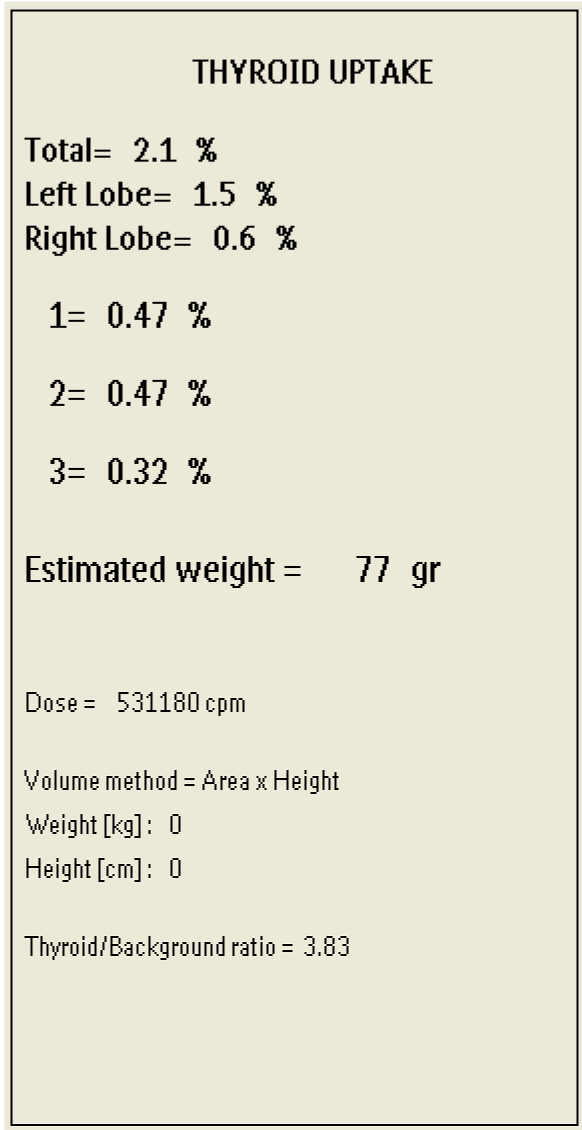

Figure 292 Results on the Final page

The results in this example show the Total uptake in the thyroid as the sum of the uptakes in left and right lobes. Also shown is the uptake per nodal region and the estimated weight as calculated by the Area x Height method indicated by “Volume method =” label.

The Dose value in cpm is the calculated applied dose from either syringe data, capule data or images data with proper decay corrections.

The Weight and Height are copied from the entries on the Select page.

The Thyroid /Background ratio display is controlled by the default setting “Display Thyroid/Background ratio” and can therefore be switched off.

Time of Thyroid acquisition p.i or p.o display is controlled by the default selection: “Display time lapse p.i or p.o?” and can also be switched off.

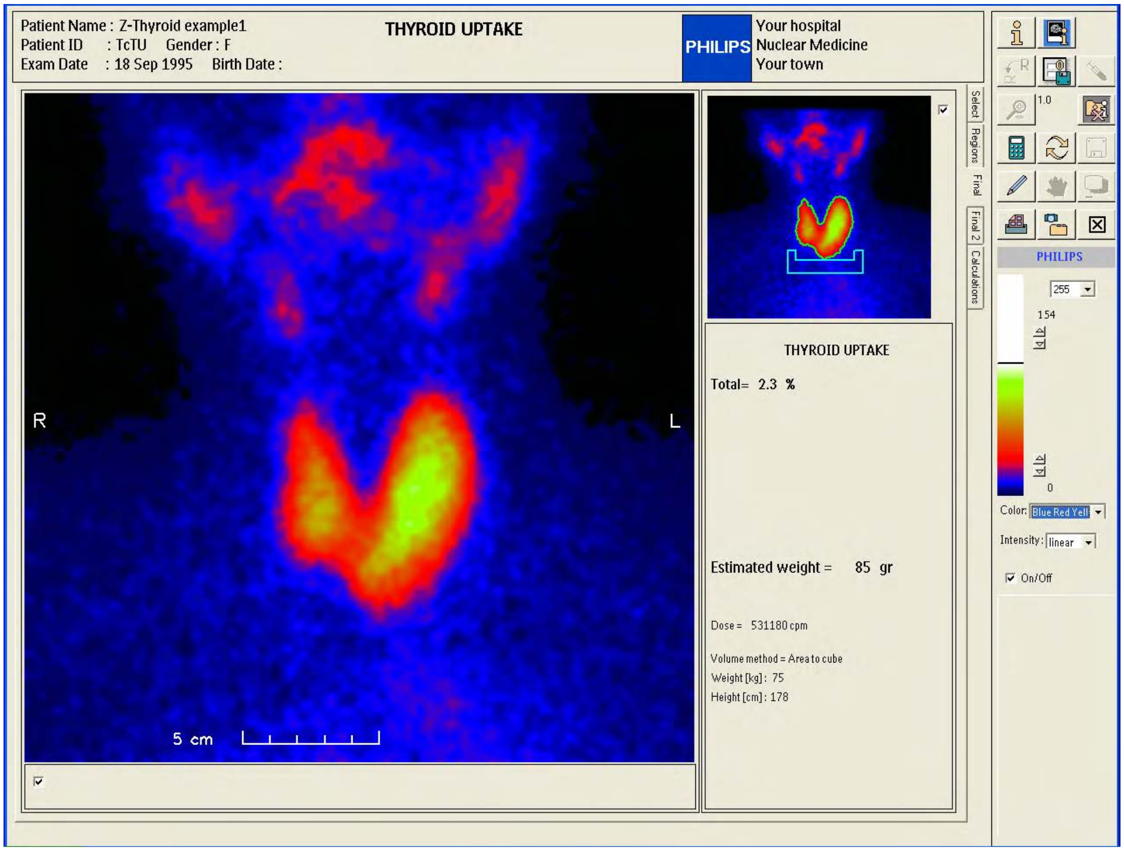

Figure 293 Final page.

In this example final display only the Thyroid and Pre-injection images were selected. Only the single thyroid and background ROIs were drawn while the calculation of the Thyroid/Background ratio and Time of acquisition p.i/p.o ldisplay were switched off in the Defaults panel. The volume was calculated by the Area to Cube method that only uses the full single thyroid region.

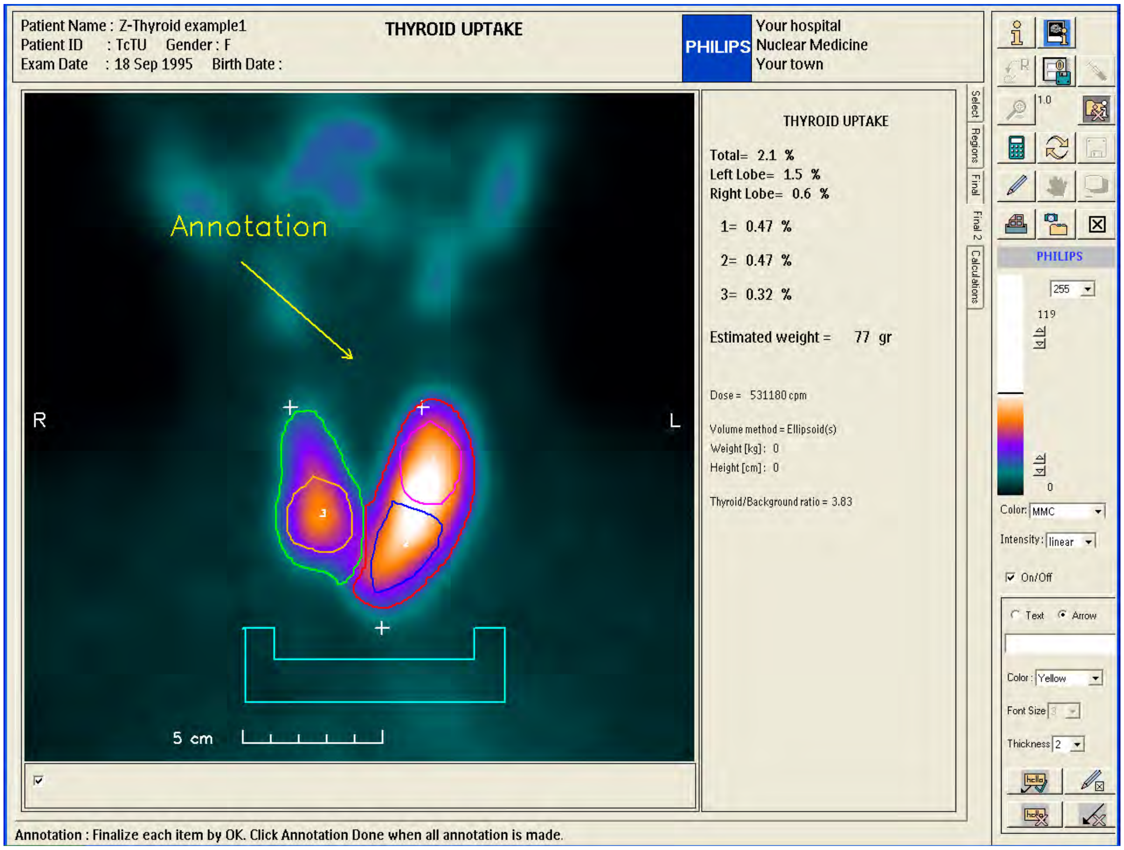

Figure 294 Final 2 page and Annotation entered.

On this final page the regions are displayed on the large image, there is no separate image for regions. Notice that three nodal regions were selected, their uptake appears below the Total uptake in the right hand panel. Annotation is available on both final pages.

30.8 Calculations Page

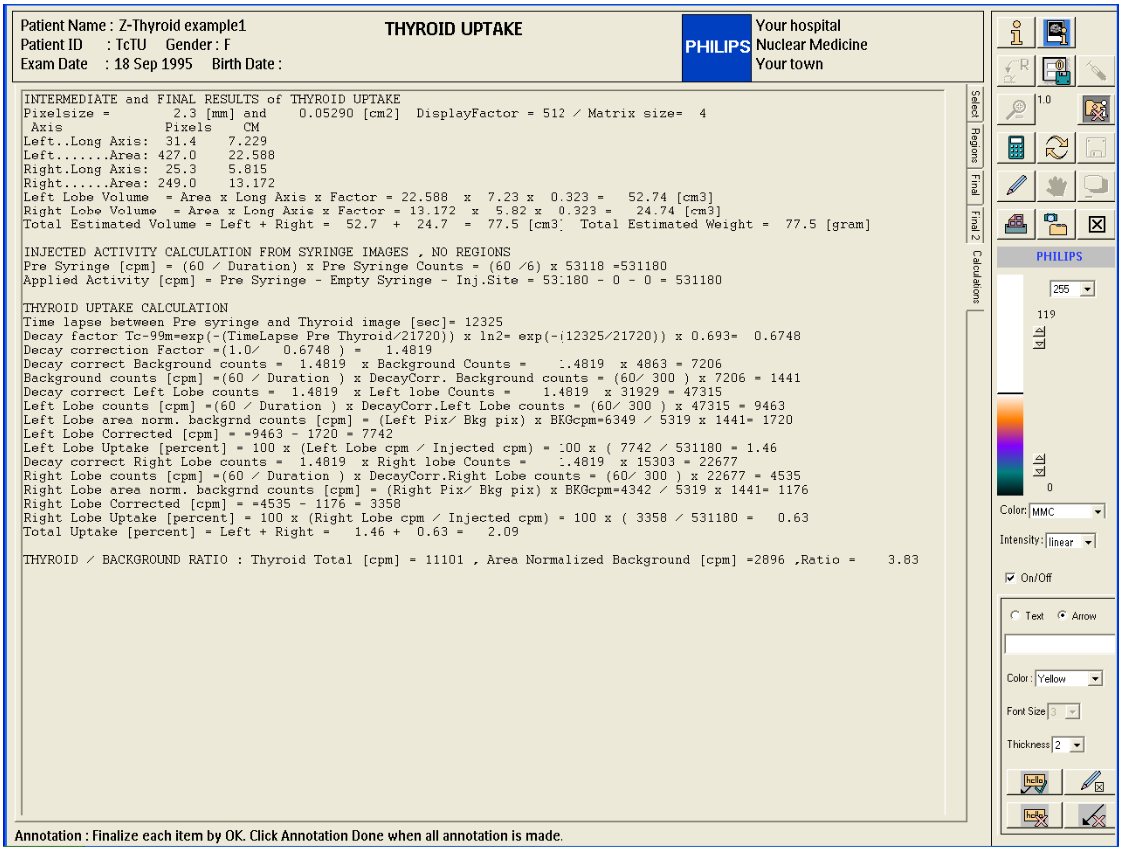

Figure 295 Example Calculations page.

The Calculations page shows intermediate and final results of the calculations internal to the application. The results presented here allow for an easy verification of the program outcome.

The page shows the following sections:

- Volume calculation
- Applied activity calculation
- Thyroid uptake calculations
- Thyroid /Background ratio calculation

30.8.1 1.0 Volume Calculations

1.1 Method 1: Area x Height

The volume of each Lobe is estimated by multiplication of the Area of a lobe in cm2 times the Long axis in cm.

The area of a lobe is calculated by converting the number of pixels in the user drawn region to cm2. The total volume of the Thyroid is obtained by adding the volumes of the Left and Right lobe. The Thyroid volume is estimated by multiplying this volume by a constant.

Thyroid volume = 0.323 x Volume [cm3]

It is assumed that 1cm3 = 1 gram therefore the Thyroid weight is the same resulting value in grams.

1.2 Method 2: Area to Cube

The volume of the total thyroid is estimated by calculation of the Area of the region of interest in cm2 as above, then multiplication of the area by the square root of the area.

In formula : V =(SquareRoot (Area)) x Area.

Then the Thyroid volume is estimated from V by multiplication with a factor.

Thyroid volume = 0.3.26 x V

It is assumed that 1 cm3 = 1 gram therefore the Thyroid weight is the same resulting value in grams.

This method was proposed by Standke e.a in 1983.

Ref: “Globale und regionale Computer Funktionstopografie der Schilddrüsse”, R. Standke e.a Nucl.-Med. Band XXII/Heft 6, 1983

1.3. Method 3: Ellipsoids

The volume of each lobe is estimated by using the long and short axis lengths calculated in cm from number of pixels and pixel size.

The volume of an ellipsoid is given by the formula:

Volume = π /6 * short axis * short axis * long axis

The total volume is the sum of the left and right ellipsoid volumes. It is assumed that 1 cm3 = 1 gram therefore the Thyroid weight is the same resulting value in grams.

30.8.2 2.0 Applied Activity Calculations

All calculations are in counts per minute [cpm], this means that if images or regions are used in calculations that the data is normalized to counts per min. E.g. if the Injection site image was acquired for 20 seconds then the counts from that image are multiplied by 60/20 = 3.

2.1 Dose calibration factor: This factor must be determined before you can do any calculations using Capsule or Syringe data entries

You have to determine this factor from the way you measure and enter the activity in either MBq ,cpm or mCi. The activity in MBq , cpm or mCi, multiplied by the calibration factor must represent the counts per minute that the gamma camera sees when the activity to apply is placed in front of the collimator. If you enter the activity in cpm this factor should be 1.0

If you use MBq as units,the Calibration factor must indicate how many counts per minute are counted by the camera if 1 MBq is measured (cpm/MBq). In the same manner the factor would say the cpm if 1 mCi was measured and you enter the activity in mCi (cpm/mCi).

2.2 Capsule data

The applied activity is calculated as Capsule activity times the Dose Calibration factor.

2.3 Syringe data

The applied activity is calculated as Pre-Syringe activity times the Dose Calibration factor minus the decay corrected Post syringe x Dose calibration activity.

The Decay correction is based on the selected isotope, Tc-99m, I-123 or I-133, and the time between the Pre and Post Syringe measurement clock time , including multiple days if selected as entered on the Select page panel.

In the case that an Injection site image was selected, the counts in the region on that image, corrected for decay from the time of Pre-Syringe measurement to Injection site image acquisition time are subtracted.

Applied dose= Pre-Injection – Decay Corr. Post-Injection – Decay Corr Injection site counts

2.4 Syringe images

2.4.1 No regions

There are four scenarios here:

A: Pre-injection syringe image only.

B: Pre and Post injection syringe images

C: Pre- and Post and Injection site images

D: Pre-Injection and Injections site images.

The counts of the Pre-injection and (if available) Post-injection images are determined and converted to counts per minute.

The decay factor for the post-syringe image is calculated from the isotope and time lapse between pre and post syringe images as read from the image headers.

If an Injection site image was selected the counts in the region on that image are used in the calculation. The counts are converted to counts per minute and corrected for decay caused by the time from pre-injection to Injection site image acquisitions.

A: Applied activity = Pre–Injection counts

B: Applied activity = Pre-Injection minus Decay corrected Post-Injection counts

C: Applied = Pre – Decay Corr. Post – Decay Corrected Injection site counts

D: Applied = Pre - Decay Corrected Injection site counts

2.4.2 Regions on syringe images

This situation is the same as 2.4.1 with the exception the ROIs are used on the Pre-Injection and Post-Injection image to determine the counts of the full and empty syringes.

2.5 Capsule image

In stead of a Pre-injection image of a syringe an image of the Capsule is used. If "Regions on syringe images" is set to yes in the Default, you must draw a region on the Capsule image to determine the counts. These counts are the converted to counts per minute and used as the applied activity.

30.8.3 3.0 Thyroid Uptake calculations

The decay factor for counts in all thyroid regions, including the background is determined by the isotope selection and the time lapse between the Pre-Injection /Capsule measurement/ acquisition time and the time of acquisition of the Thyroid image. The counts in all regions are corrected for this decay and converted to counts per minute.

The background counts are area-normalized for each thyroid region (one or two lobes, nodal regions) and then subtracted.

The uptake percentages per thyroid region are then determined by the ratio:

(region counts / applied counts) x 100%

30.8.4 4.0 Thyroid /Background ratio calculations

The counts in the background region are area-normalized to the size of the thyroid region, where the thyroid region size is one region or the sum of the left and right lobe sizes.

The ratio is then calculated as: Thyroid counts / area normalized Background counts

31 Parathyroid Variable Subtraction

31.1 General

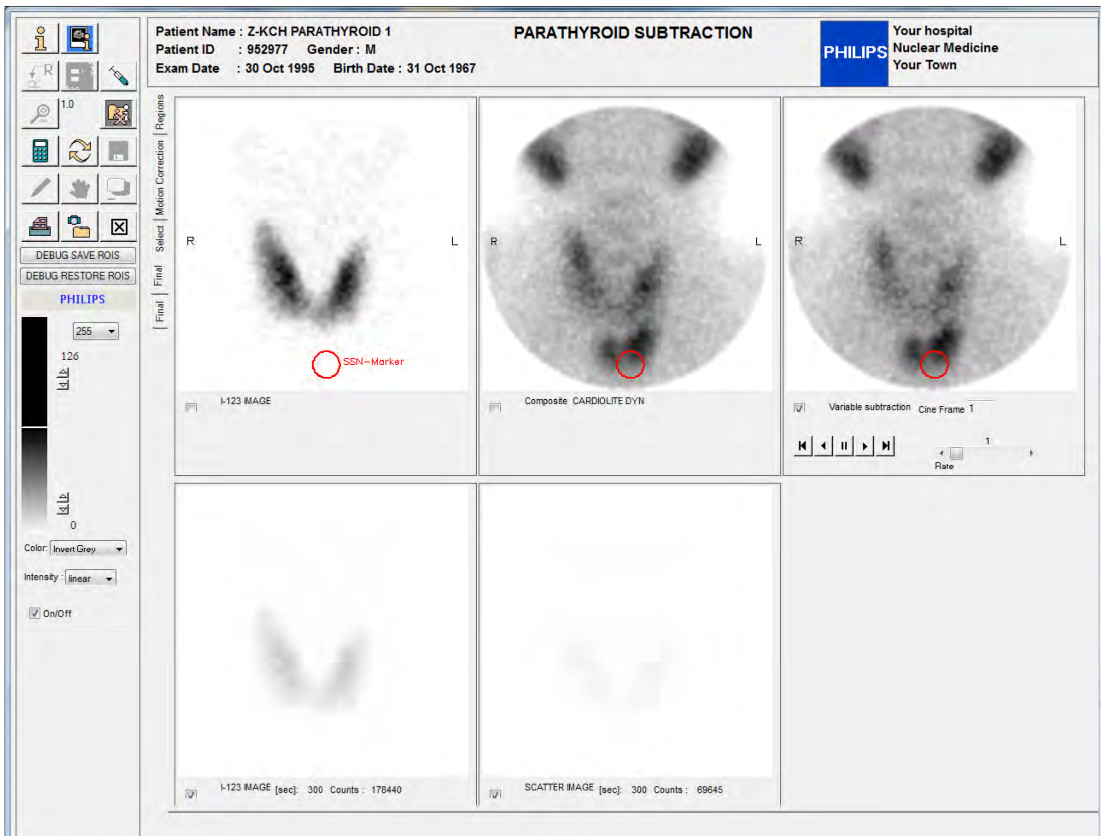

Figure 296 Parathyroid Variable Subtraction application

This application generates parathyroid subtraction images from a dynamic Tc-99m Rp30 (Sestamibi) image, a static I-123 image, and a scatter image. The application can also be used for two static images, Tl and Tc, to generate the dynamic and static subtraction images. It allows alignment of the individual images within the dynamic set, removal of early vascular frames for a composite image, and a cine display of various levels of subtraction. An SSN (suprasternal notch) marker image allows anatomical identification. The method was developed by the Kent & Canterbury hospital in Canterbury, UK.

31.2 Acquisition

- All images are in 128x128 x 8
- Collimator: pinhole
- Static planar 300 sec I-123 image of the thyroid
- Static planar 10 sec SSN marker image, Co-57 image of pen marker
- Static planar 300 sec Tc-99m scatter image
- Dynamic planar, 10 frames of 120 seconds each, Tc -99m sestamibi

Procedure (as used at Kent & Canterbury):

The four planar image sets are taken with a pinhole collimator with extreme care taken in maintaining the patient geometry. The current advice is that, additionally to the pinhole images of the anterior neck, an anterior view of the mediastinum with parallel hole collimation is required following the completion of the dynamic Tc-99m sestamibi acquisition.

Request form: If the patient has had previous surgery to the neck for whatever reason, increased doses of the two tracers may be needed. With some patients, late images of the parathyroid using parallel and pinhole collimators is required.

Preparation: None prior to administration of drink

Oral administration: Patient is given 20MBq of I-123 solution as a drink. (This can be increased - see text above)

Delay: 4-5 hours

Camera: Fitted with pinhole collimator

Patient preparation before scan: A butterfly IV line s inserted in a suitable vein and flushed with hepsal/hepflush.

Patient Positioning: Supine on low (thyroid) imaging bed, with head positioned in a head support, neck extended by foam padding under the shoulder as required. You can alter orientation to accommodate a patient positioned with the feet to the end wall or the opposite way around. Adjusting position like this is quite common as many parathyroid patients are also hemodialysis patients and have fistulas in situ. Using a Co-57 pen marker (using Co-57 window), make sure that the neck is completely within the field of view. Make sure that the camera is returned to the I-123 window setting before commencing acquisition.

- Data acquisition: All views acquired using predefined acquisition protocol PT
- Parathyroid Scan: Do not move the patient between images.
- 300 second static I-123 image of the thyroid
- 10 second static Co-57 image of SSN marker (pen marker)

- 300 second static Tc-99m scatter image
- A dynamic Tc-99m acquisition of 10 frames, 2 minutes per frame. 200MBq of Tc-99m sestamibi (400MBq if dose is increased) is administered through the butterfly followed by a normal saline flush. Start the acquisition once you begin flushing the dose. Do not move the patient from the bed until acquisition is complete.

31.3 Button Panel and Image Controls

See Chapter 1, “Getting Started.”

31.4 Processing

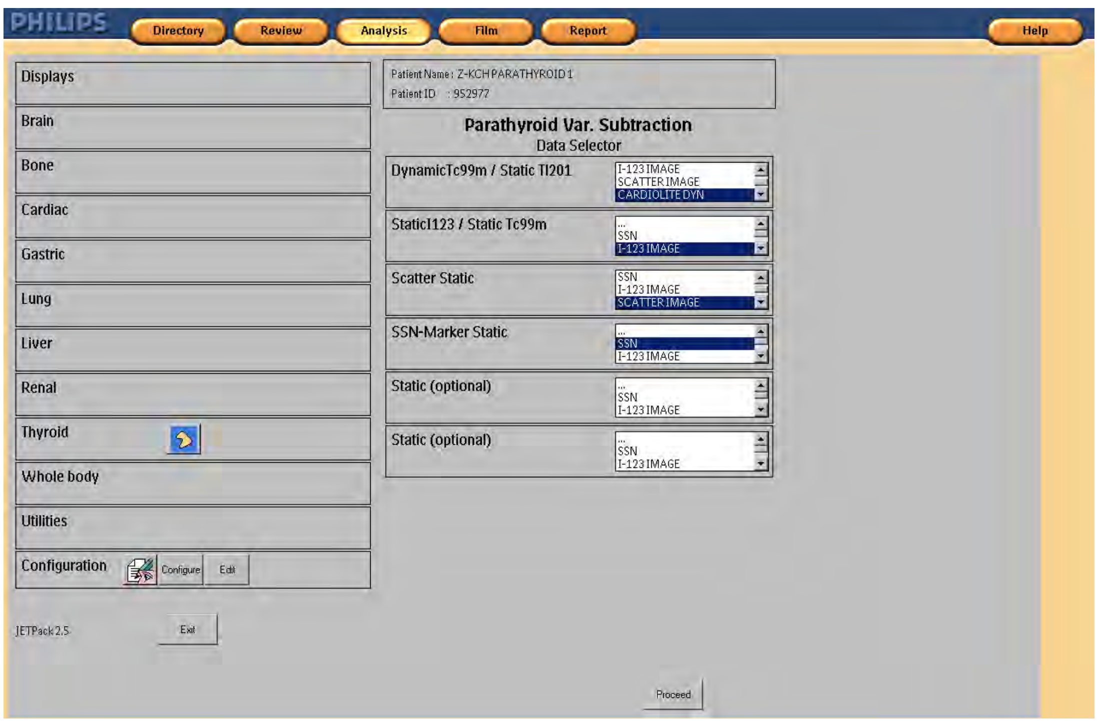

Figure 297 ISP JETPack panel, Parathyroid Variable Subtraction application selected

If required adjust the selected file in the data bucket and click **Proceed**.

1 Select the static I-123 image, the dynamic Tc-99m Sestamibi image, the scatter image, the static SSN marker image, and up to two optional images for display only.

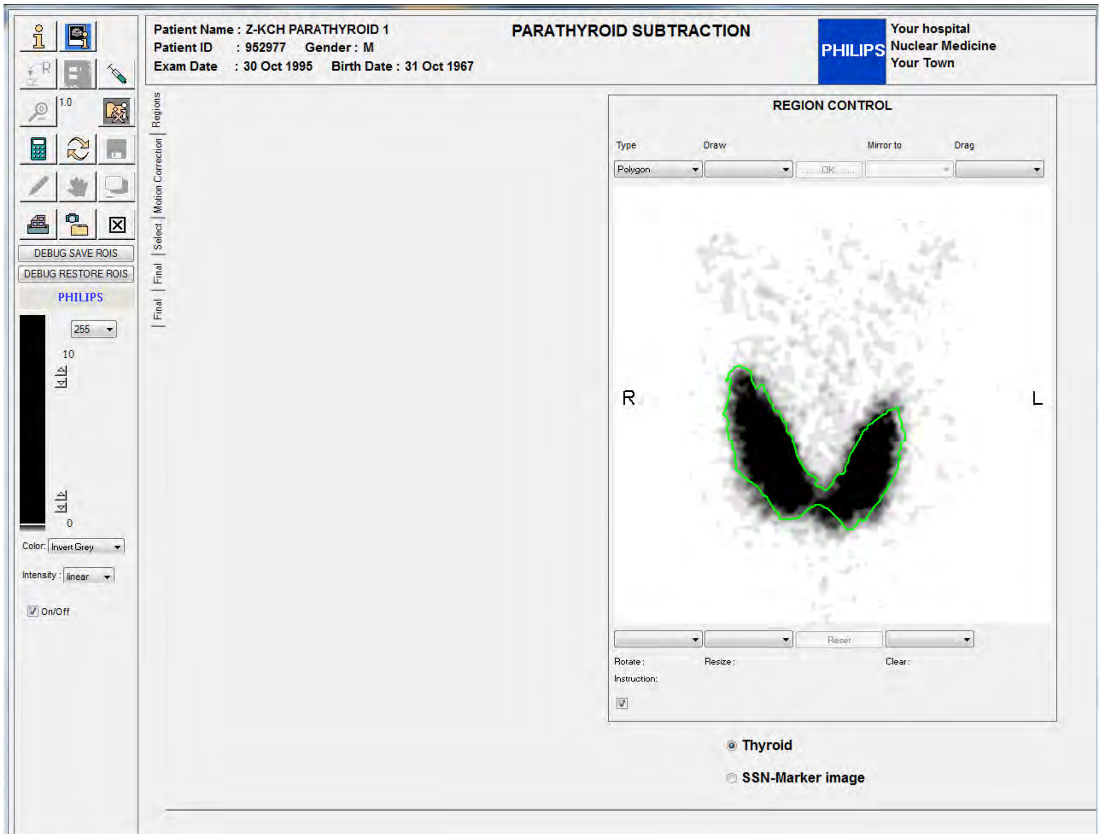

Figure 298 Region Page with the Thyroid I-123 image displayed

Note You can select either the SSN Marker image or the I-123 image with the radio buttons.

2 Draw an ROI (see Figure 298).

Use the Standard Region Controls in **Polygon**, **Freehand** or **Iso Free** mode around the whole thyroid.

Note The region menus have only one single region available: Thyroid.

You can use the region later to align individual composites of the dynamic image.

3 Switch the display in the region editor to the SSN marker image (Figure 299).

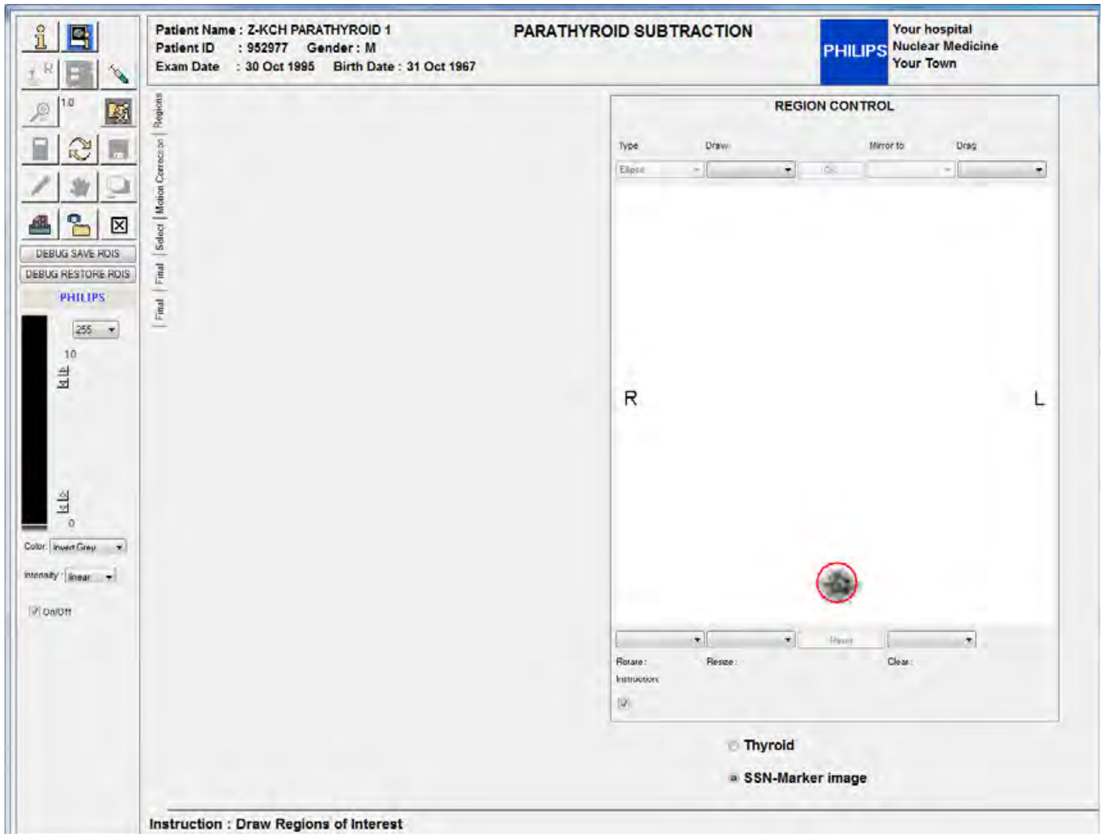

Figure 299 SSN marker image and region in the Region editor page

4 Mark the center of the activity by means of the **Ellipse** option in the region control.

5 When completed, select the **Motion Correction** page (Figure 300).

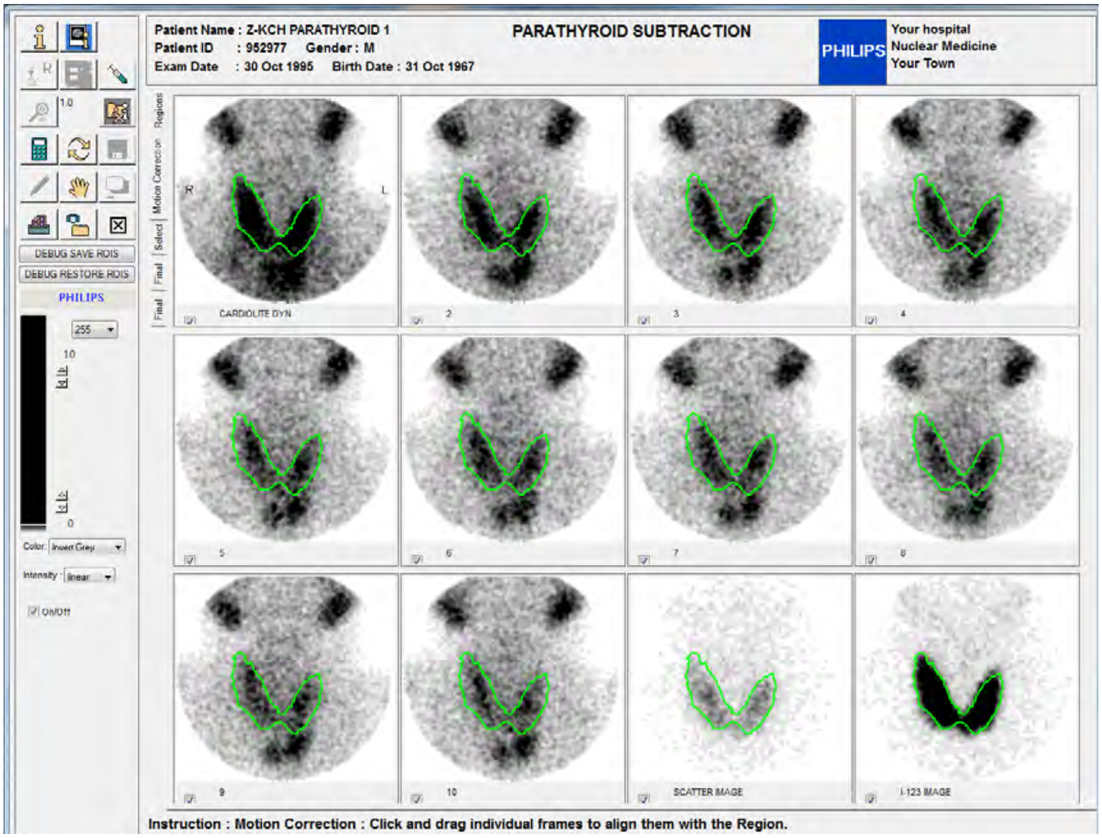

Figure 300 Motion Correction page

The input dynamic image of 10 frames of 2 minutes each is shown as individual images in Figure 300. The thyroid region is superimposed on each image to detect any motion during acquisition.

To align an image with its region, click and drag individual frames to align them with the region. Repeat dragging other images with respect to their own region if so desired.

Note The scatter and I-123 thyroid images are shown in the bottom right corner of the page.

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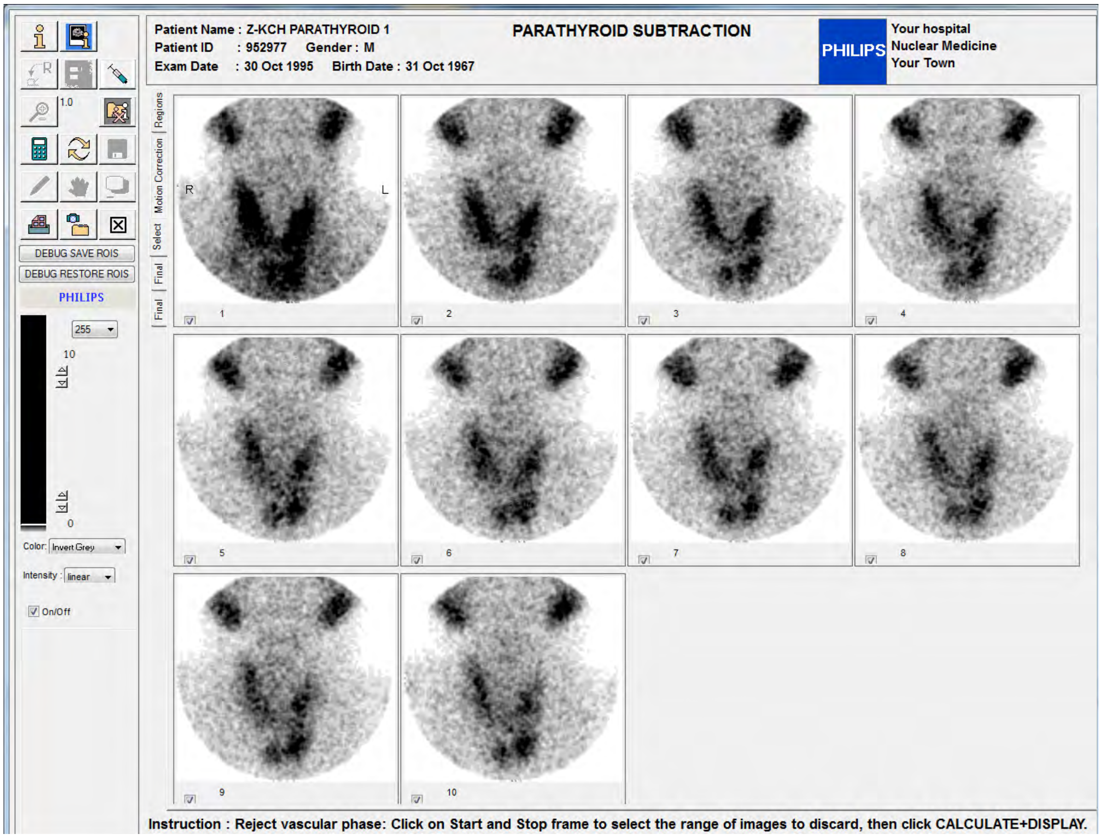

Figure 301 Select page

The rejection shows the motion corrected composite images and the I-123 image.

This page allows removal of the frames of the dynamic image that you want to reject from the dynamic Tc-99m image, usually the early vascular phase.

Click on the start and stop frames to select the range of images to discard.

Click **Calculate & Display** to process and display the final window.

31.5 Final Page

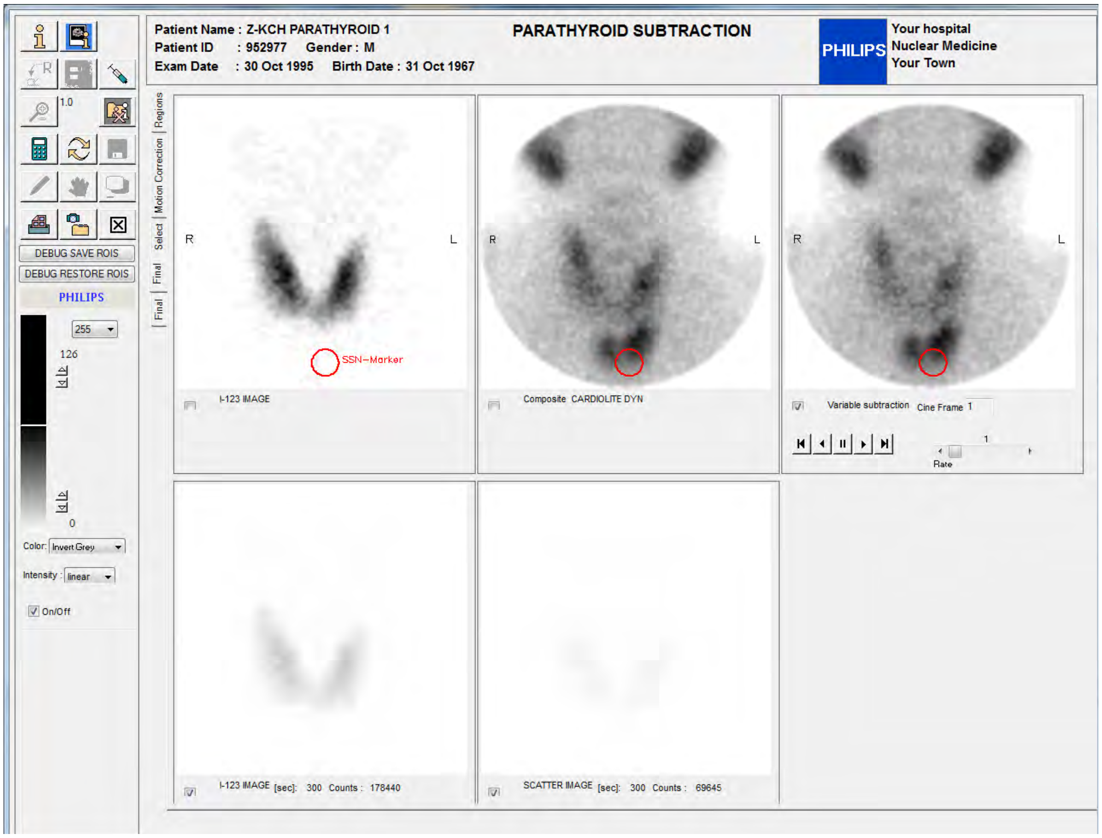

Figure 302 Final page

The final page (Figure 302) shows the I-123 image with SSN marker, the composite Tc-99image corrected for scatter, and the dynamic variable subtraction parathyroid image.

The parathyroid image appears in a cine-control-style viewport to allow selection of the desired image or display the variable subtraction in cine mode.

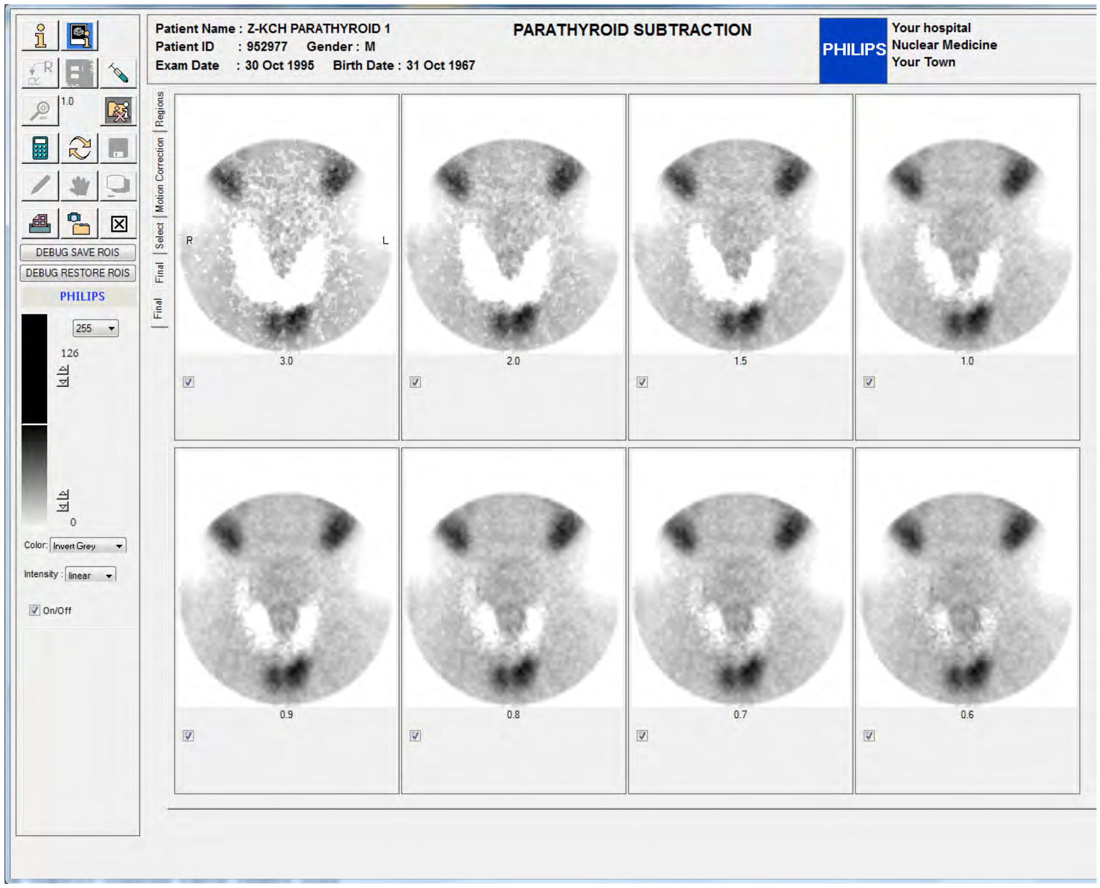

Figure 303 Final page with fixed subtraction rates 3.0 , 2.0, 1.5, 1.0, 0.9, 0.8, 07 and 0.6

31.6 Calculations

The remaining composite images after motion correction and rejection of vascular phase are added to build a summed Tc-99m composite image.

The scatter image is time-normalized to the acquisition time of the summed composite image and then subtracted. A dynamic variable subtraction image is generated by subtraction of a variable amount of the I-123 image from the summed Tc-99m composite image.

Variable subtraction is determined as follows:

Calculate the counts in the region on the I-123 and Tc-99m summed composite image as I-123Counts and TcCounts.

Top = 2 x (TcCounts / I-123Counts)

Bottom = 0.1 x (TcCounts/I-123Counts)

These values are then used to calculate the range of 30 Factors for determination of the variable amount of subtraction of the I-123 image from the summed composite Tc-99m image.

Result image = Tc-99m image - (Factor * I-123 image)

31.7 References

Coakley AJ et al; 99mTc-Sestamibi- a new agent for parathyroid imaging. Nucl Med Communications 1989; 10: 791-794

O'Doherty MJ et al: Parathyroid imaging with Technetium-99m-Sestamibi: Preoperative Localization and Tissue Uptake Studies. J . Nucl Med 1992; 33: 313-318

Coakley Aj; Parathyroid imaging Nucl Med Communications; 1995; 16: 522-533