



Smart Segmentation
Knowledge Based Contouring®
Instructions for Use



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Abstract	The <i>Smart Segmentation Knowledge Based Contouring</i> ® Instructions for Use provides basic information and procedures for using the <i>Smart Segmentation Knowledge Based Contouring</i> ®, Version 2.0 software. This document is the English-language original.
Manufacturer	Varian Medical Systems, Inc. 3100 Hansen Way Palo Alto, CA 94304-1030, USA
European Authorized Representative	Varian Medical Systems UK Ltd. Gatwick Road, Crawley West Sussex RH10 9RG, United Kingdom
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WHO

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- International Classification of Diseases for Oncology, (ICD-O) 3rd edition, Geneva, World Health Organization, 2000.

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Chapter 1 Overview of Smart Segmentation

Knowledge Based Contouring

Smart Segmentation Knowledge Based Contouring® allows you to automatically create structure sets for a treatment planning CT that includes the Clinical Target Volumes (CTVs) and appropriate Organs At Risk (OARs).

You initiate segmentation through selection of an expert case saved in the database. Different filter options allow you to select the expert case that best matches your requirements.

With various 2D and 3D tools you can edit structures and adapt according to clinical preference.

Structures are reviewed and approved for further processing.

Expert cases can be copied and then edited and you can add your own cases to the database.

An anatomy atlas is provided as a feature of the application. It is intended for use as a reference tool. It allows quick review of different anatomical regions.

Intended Use

Smart Segmentation Knowledge Based Contouring® provides a combined atlas and model based approach for automated and manual segmentation of structures including target volumes and organs at risk to support the radiation therapy treatment planning process.

This manual is intended for qualified operators (oncologists, physicists, dosimetrists or advanced therapists) of the *Smart Segmentation* application.

Visual Cues Used in this Instruction

This section presents the types of notes and precautionary notices used in the guide, along with their icons. The following notational conventions are used:



Note: *A note provides non-critical information, such as user requirements, computer messages, suggestions, and shortcuts, which can help the user to obtain optimum performance from the equipment and software*



CAUTION: A Caution describes actions or conditions that could result in minor or moderate injury or damage to equipment or loss of data. All Caution notices must be obeyed.



WARNING: A Warning describes actions or conditions that could result in serious injury or death. All Warning notices must be obeyed.

Bold Text

This guide uses bold text for:

- Menus and menu commands. Example: Choose **Edit > Delete**.
- Command buttons. Example: To confirm, click **Yes**.
- Option buttons. Example: In the dialog box, select the **3D** option button.

Quotation Marks

This guide uses quotation marks for:

- Internal cross-references, for example, see “Adding a New Patient” in this chapter.
- Text that displays in a window or dialog box, for example, the status bar text reads “Mean error 13”.

Italics

This guide uses italics for:

- References to other publications, for example, refer to *Using ARIA manual*.
- Emphasis, for example, *Always* verify plans visually.
- Workspaces. Example: Annotations can be introduced when in the *Acquire* workspace.

Contact Varian Customer Support

Support services are available without charge during the initial warranty period. Use this contact information to get additional copies of documentation or to search for documentation online.

Create a Varian Account

1. Go to <http://my.varian.com>.
2. Click **Create New Account** and follow the instructions.

Establishing an account may take a few days.

Contact Online Support

1. Go to <http://my.varian.com>.
2. Click **Contact Us** at the top of the window.
3. From the Contact Us page:
 - Use the appropriate link to send an e-mail to Varian support.
 - Call the contact number displayed in the upper right corner.
 - Click the **International** support link to display a complete list of international e-mail addresses and telephone numbers.

Find Local Support for Service, Parts, or Training

1. Go to <http://my.varian.com>.
2. In the Services & Support menu, choose **Oncology Support**.
3. Click **Contact Varian Oncology** on the right side of the screen.
4. Select the geographical area for the support you want.

E-Mail Addresses

If possible, send all e-mail inquiries through the my.varian.com website. Otherwise, use the appropriate e-mail address for support:

■ North America	support-americas@varian.com
■ Latin America	soporte.al@varian.com
■ Europe	support-emea@varian.com
■ Australia & New Zealand	support-anz@varian.com
■ China	china.apps.helpdesk@varian.com
■ Japan	japan.apps.helpdesk@varian.com
■ South East Asia	SEasia.apps.helpdesk@varian.com
■ Brachytherapy Systems	brachyhelp@varian.com
■ Medical Oncology	vmosupport@varian.com

Phone Numbers for Support

For information not included in this publication, call Varian Medical Systems support at:

■ United States and Canada telephone support	+ 1 888 827 4265
■ United States and Canada Direct telephone support	+ 1 650 213 1000
■ European telephone support	+ 41 41 749 8844
■ Fax (US)	+ 1 702 938 4754
■ Fax (Service Europe)	+ 41 41 740 3340
■ All other countries	Call your local service office.

Browse for CTBs and Other Documents

Customer Technical Bulletins, manuals, and other resources are available for Varian Oncology products.

1. Go to <http://my.varian.com>.
2. From the MyVarian home page, click Product Information on the left side of the screen.
3. Click the name of the product for which you want information on the left side of the screen.

Documents include:

- Manuals
- CTBs
- Release Notes
- Education Materials
- Webinars
- Application Quick Tips

Phone Numbers to Order Documents

Call Varian Medical Systems support at:

- | | |
|----------------------------|--------------------------------|
| ■ United States and Canada | + 1 888 827 4265 |
| telephone support | (Press 2 for parts) |
| ■ All other countries | Call your local Varian office. |

Related Publications

For additional information , refer to the following source:

- *Smart Segmentation Knowledge Based Contouring Reference Guide*

Chapter 2 Safety

This chapter provides general safety precautions which apply to the general operation of Smart Segmentation Knowledge Based Contouring® and all associated equipment. Specific warnings and cautions describing a particular hazard are given in the procedures.

The hospital is responsible for establishing emergency and safety procedures to ensure safe operation and maintenance conditions.

Where applicable, hardware and software are designed to meet current international technological and safety standards, for example, IEC for the protection of users and patients.

Since hazards can be encountered, and risks cannot be ruled out completely, instructions and procedures in the manuals must be followed to guarantee safety of the patients.

Any use of the system and software which does not comply with the agreed use described in this manual or other related Varian manuals is prohibited.

The system must only be run with its original and unmodified fittings and replacement parts.

Modifications or adjustments to the system or its parts are not permitted, unless with prior approval and check by Varian.

Varian is not responsible for any use of the system and/or software which does not comply with the agreed use described in this manual or other related Varian manuals.

No modifications may be made to the software.

Care Required

Careless handling or operating can result in poor performance, equipment and environmental damage, potential fire hazards and personal injury or death.

The equipment must be handled with care and kept in a good and safe condition as described in the system manual..



Note: Users must not share their login information.

The user takes full responsibility for any contours exported to the Treatment Planning System.

Always Handle with Care



WARNING: Careless handling or operation can result in poor performance, equipment and environmental damage, potential fire hazards, potential shock hazards and personal injury or death.

Multi-User Access



WARNING: The multi-user access warning message may appear if two or more users are accessing the same patient simultaneously (concurrent editing). It clearly states that data may be lost. These cases must be investigated and the user(s) must verify that the intended data exists in the database.

General Safety Instructions

Do not install any third party software, or updates to the operating system without instructions from Varian Medical Systems. Smart Segmentation has been validated on the operating system mentioned in the Release Notes. Varian does not guarantee normal performance of the system when third party software is installed on the system. For more information on Varian's policy regarding the installation of 3rd party software on workstations pre-loaded with Varian Medical Systems Software products, refer to *Customer Technical Bulletin*.

Check all media and data files before you use them on a computer that is used to run Varian software. Computer viruses can cause corruption of data files and adverse effects in software that run on computers infected by a computer virus. For more information on appropriate virus protection, refer to *Customer Technical Bulletin (Varian Medical Systems Anti-Virus Software Policy)*.

Always check the patient information displayed on screen to make sure that you are working on the correct patient. The patient information is displayed in the title bar of the application main window.

Always review, and if necessary correct, the automatically segmented structures in the treatment planning system. Typically, some corrections and modifications of the contours will be required prior to proceeding with treatment planning.

Chapter 3 Expert Case Segmentation Mode

The expert case segmentation provides you with a planning CT containing all relevant structures of organs, organs at risk and CTV's.

Automatic Segmentation Process

Load the patient volume image.

Start the expert case segmentation mode, click **Segmentation > Segmentation Mode**. Selection in the the *Expert Case Browser* can be made through the three different tabs, allowing to *Search Tumor Site*, *Free Text Search* or searching *Favorites*.



Caution: Make sure to select the expert case appropriate to your requirements.

Search Tumor Site

Select the tumor site from the drop-down list. This filters all cases in the database with the selected tumor site. Dependent on the tumor site, further filter options may become available. Use the filter criteria to narrow your search. A maximum of 100 cases are displayed.

Click on a column header to sort the results by this column in ascending order. Click again to sort the results in descending order.

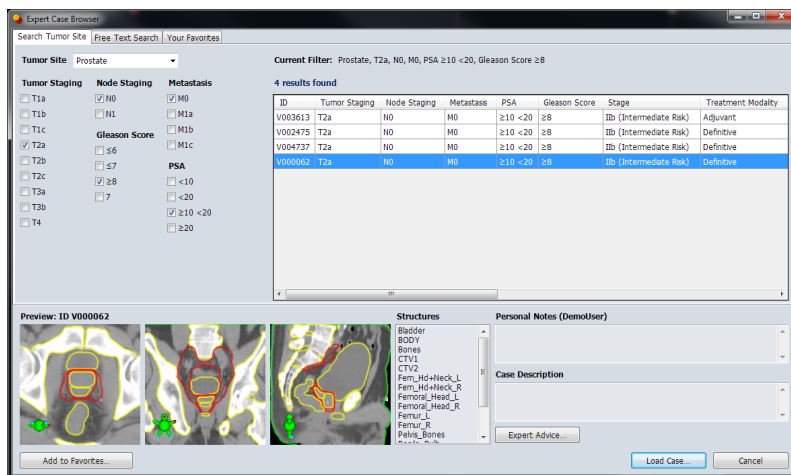


Figure 1 Expert Case Browser

The current filters applied to the cases are shown above the list of found cases. Click once on a case entry to open the preview section. The preview section shows thumbnails of the CT data and structures in three views, a list of structures available in that case and, if available, personal notes and a case description. Click on **Expert Advice** to view the expert advice saved with that case. To add this case to your favorites list, click **Add to Favorites** and accept the proposed case name or specify your own name. To open the case click **Load Case**.

Free Text Search

This tab allows you to filter the cases for one or more words entered. Multiple word entries are interpreted with a logical AND operator. Activate the checkbox to Include Expert Advice text in your search.

Use quotation marks “ ” to search for the exact matching string. Without quotation marks you search for substrings.

Use the context menu to copy either a single case specification line or the entire case table to the clipboard.

Favorites

Cases in the favorites tab are listed according to the case name given. You can sort these cases with the use of the arrow buttons. Rename a case with the use of the context menu.

Start Segmentation

With the selection of the expert case the 6 view-layout is started. The patient volume image is shown on the three planes on the left half of the screen, the expert case ID is indicated on top of the right half of the screen.

The expert case CT is automatically prealigned to the planning CT with the use of anatomical landmarks.

At this point, the expert case used for segmentation can still be changed. To *change* the expert case click **Segmentation > Open Expert Case** to bring up the expert case browser.

To start the segmentation click **Segmentation > Run Segmentation**. The run segmentation window opens, indicates the tumor site and tumor specific properties. In the structures part of the window all structures available are listed. By default the checkboxes of all structures are set to active for segmentation. Select the structures required. Click **Start Segmentation**.

If the segmenting progress needs to be interrupted click **Stop Segmentation**. You then return to the run segmentation menu. This allows you to change your selection.

Upon completion of the segmentation cycle the new structures are shown in the patient volume image in the left half of the screen.

To add additional structures through the Segmentation process, click **Run Segmentation** again and repeat the steps mentioned before.

To exit the Segmentation mode and return to the 3 view layout click **Segmentation Mode**.

Review and edit the contours if necessary. Approve the results. (See Chapter 4).



Note: *Should the automatic prealignment fail, please align and/or rotate the expert CT manually. The tool required is displayed automatically.*



Note: *To copy, edit or add your own expert cases please refer to Chapter 5.*

Chapter 4 Structure Review, Edit and Approval

All images and structure sets are automatically displayed when a patient file is loaded. Uncheck the visibility checkboxes of the structures you would like to hide in the image layout.

View Structures

You can view segmentations in 2D as contours or in 3D as structures.

View Contours in 2D

The outlines of the selected structures are shown as contours in all orthogonal views.

- Scroll between planes in the orthogonal views to display different parts of the structure.
- To center a selected contour in all orthogonal planes, select **Move Viewing Planes to Structure** in the **View** or in the context menu.

View Structures in 3D

To view structures in the three dimensional view:

1. Select **4 views** display from the **Select View Layout** icon in the toolbar.
2. From the **3D display** context menu select **Surface**.
3. To view internal structures, select **hide** body outline in the context menu or use the structure visibility checkboxes. Use the same procedure for all other structures.

Edit Structures

You **can** edit structures in any of the orthogonal views for both single-image and blended views.

Structure Selection

To select a structure for editing, use one of these methods:

- Click the structure in the structure set list. The selected structure is displayed in bold white font. Several structures can be selected by pressing the **Ctrl** key while selecting.
- Click the structure outlined in the image. Several structures can be selected by pressing the **Ctrl** key while clicking the structure.
- Hold the left mouse button while expanding the red rectangle to enclose the structure(s) to be selected.

Stretch and Compress Contours in 3D

- Modify existing structures using the **Transform Structure**, **Deform Structure** or **Diffusion Brush** tool (for details, see *Smart Segmentation Reference Guide 2.0*).

Delete a Structure

Delete Structure permanently removes a contour from a data set. To delete an existing structure:

- Right click the structure in the structure set list to display the context menu. Select **Delete**. Confirm the deletion in the pop-up dialog.

Clear a Structure

Clear Structure removes a contour from the image display, while the structure is retained in the structure set list.

- Right click the structure in the structure set list to display the context menu. Select **Clear**.

Add a Structure

- To add a structure to an image already containing a structure set, select **New Structure** from the **Segmentation menu** or the context menu of the content preview.
- If no structure set is present, the menu item is changed to **New Structure Set and Structure** which can be used to add both.
- To draw a free-hand contour, select the **Planar Contour Drawing**  tool and select **Freehand Mode** from the context menu.
- To draw a polygonal volume, select the **Planar Contour Drawing**  tool and select **Polygon Mode** from the context menu.
- To draw a closed contour, select the **Brush**  tool. You may have to select 2D mode from the context menu, depending on your system configuration.
- To draw a new volumetric (3D) structure which is extrapolated to adjacent planes, select the **Volumetric Contour Drawing**  tool. To draw a closed volume, select the **Brush**  tool and select **3D** mode from the context menu.
- To erase a contour, select the **Eraser**  tool.
- Use the **Diffusion Brush**  for complex structures



Note: Smart Segmentation supports only one structure set per volume image. Therefore, to create a new structure set for an image already containing structures the existing set needs to be deleted first

Semi-automatic Drawing

PET Sub-volume Thresholding

To draw contours based on pixel intensity in a PET image select **PET Sub-volume Thresholding**  and click on the area of highest PET activity within the tumor. If you wish to limit the search area of the algorithm to a specific area of the image:

- Activate the **ROI** tool . Adjust the ROI drag the corners of the red rectangle, or press **Ctrl** and draw a new rectangle with the mouse cursor.
- Click on the area of highest PET activity within the ROI.
- Change the SUV threshold value with the slider on the bottom of the screen.
- If you want to include another hot spot into the contour, move the ROI to the next hot spot and click on the preferred area. If you want to discard the contoured area, use **Clear Structure**.



Note: *It is crucial for the quality of the segmentation that the user accurately clicks in the area with the highest visible activity. Areas of higher activity than the selected one will be excluded from the segmentation. The user is advised to carefully verify the structure and may need to click in the areas of highest activity (= excluded areas) again in order to include it.*

Image Thresholding

The **Image Thresholding** tool allows you to draw contours based on pixel intensity.

- Select a structure and press  to display a histogram of the intensity distribution of the image.
- Change the thresholds to optimize segmentation.
- To modify only part of an image, first define the volume of interest (VOI) using the **VOI** tool , then apply the intensity settings.

Change a Structure Approval Status

To change a Structure status:

- Open one of the following:
 - **Segmentation** menu > **Set Structure Status**
 - **Properties Dialog. Tools** menu > **Properties**
 - The **structure context** menu > **Set Structure Status**
- Select the appropriate status
- In the Status Change Confirmation Dialog verify the intended changes. Select or deselect the structures to change by checking the boxes, or by marking **Choose all structures**
- Authorize with **User Name** and **Password**

Chapter 5 Adapt Expert Case Library

Expert cases supplied by Varian are maintained and updated by Varian.

Authorized users can add a new or edit an existing expert case. The user right “Edit Template” or “Administer System” is required.



Caution: All user defined cases, including edited expert cases, are to be maintained and updated through the user.

Edit an Existing Expert Case

Any modified expert case is considered a user defined case.

Select **Tools > Expert Case Editing**

Select the case. Press **Copy Case**. A copy of the case is created with a new, unique case number. The new case is automatically selected. Press **Edit Case**.

The *Expert Case Details* window is displayed. All fields can be edited to the new case specifications except for the Case Number and the Owner.



Caution: It is essential for safe and successful treatment that you specify the attributes correctly.

You can add new structures, edit and delete existing structures. Automatic segmentation is not supported in this mode.

You either **Save** or **Save & Publish** the edited case. By pressing **Save & Publish** you allow this case to be seen by all users. To confirm your entries, enter your username and password. Just **Save** the case until the case is finalized. Your unpublished cases are listed in the “Your Unpublished Cases” tab of the expert case browser.

Create a New Expert Case

Load the patient volume image.

Perform all segmentation work required. Rename all structures according to the conventions of the User defined Case Library.

Select **Tools > Save as Expert Case**.

All patient data will be anonymized.

The *Expert Case Details* window is displayed. Enter the texts in the *Case description*, *Expert Advice* and *Personal Notes* fields. Add the keywords and specify the values to classify the case.



Caution: It is essential for safe and successful treatment that you specify the attributes correctly.

You can add new structures, edit and delete existing structures. Automatic segmentation is not supported in this mode.

You either **Save** or **Save & Publish** the edited case. By pressing **Save & Publish** you allow this case to be seen by all users. To confirm your entries, enter your username and password. Just **Save** the case until the case is finalized. Your unpublished cases are listed in the “Your Unpublished Cases” tab of the expert case browser.

Chapter 6 Anatomy Atlas

The Anatomy Atlas tool is provided as a reference guide. It displays contoured structures on a CT dataset.

Select **Tools > Anatomy Atlas**. Select the body site required in the left hand icon strip. The first slice of the selected area is displayed left of the center. Structures are shown in each slice. Use the slider to find your area of interest. Point to a structure to see its name. Click on a structure to see the information on that contour in the right hand section of the window.

For detailed information please refer to *Smart Segmentation Reference Guide 2.0*.

Appendix A Troubleshooting

Table 1 Troubleshooting

Problem	Reason	Troubleshooting
Login procedure fails and application terminates	The user may lack rights to "View Diagnostic/Planning Images".	Request appropriate user rights from your system administrator.
Application is terminated	Reading from, or saving data to, the database failed.	Contact your local IT support.
CT, MR or PET data not visible in navigation bar	Volumetric images supported only.	Switch to Eclipse Contouring workspace.
Addition of a new structure or modification of an existing structure fail	The user lack user rights. The structure is approved.	Change approval status to Reviewed.
Expert browser does not start up.	Connection to database failed.	Contact your local IT support.
Automatic alignment of expert case to planning CT failed.	Detection of anatomical landmarks failed.	Align manually.
Edit of expert case not possible.	a) Expert case is an original Varian case. b) Appropriate user rights are missing.	a) Create a copy of the case. b) Request for appropriate user rights from your system administrator.

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