RAYSTATION 2024B

Release Notes

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Declaration of conformity

CE 2862

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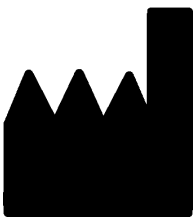
1 INTRODUCTION

1.1 ABOUT THIS DOCUMENT

This document contains important notes about the RayStation 2024B system. It contains information related to patient safety and lists new features, known issues and possible workarounds.

Every user of RayStation 2024B must be familiar with these known issues. Contact the manufacturer for any questions about the content.

1.2 MANUFACTURER CONTACT INFORMATION



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1.3 REPORTING OF INCIDENTS AND ERRORS IN SYSTEM OPERATION

Report incidents and errors to the RaySearch support email: support@raysearchlabs.com or to your local support organization via telephone.

Any serious incident that has occurred in relation to the device must be reported to the manufacturer.

Depending on applicable regulations, incidents may also need to be reported to national authorities. For the European Union, serious incidents must be reported to the competent authority of the European Union Member State in which the user and/or patient is established.

2 NEWS AND IMPROVEMENTS IN RAYSTATION 2024B

This chapter describes the news and improvements in RayStation 2024B as compared to RayStation 2024A.

2.1 HIGHLIGHTS

- Fast automated adaptive replanning.
- Automatic image import.
- Faster deep learning segmentation and a large range of new models.
- New tool for multi-mets planning.

2.2 AUTOMATED ADAPTIVE REPLANNING

- New module for automated adaptive replanning.
- The module provides an automated workflow for fast and streamlined replanning.
    - Image enhancement – optional automated image conversion.
    - Segmentation – automated segmentation of the new image set.
    - Dose estimation – automated dose computation for the scheduled plan on the new image set, to assess dose result without adaptation.
    - Adaptation – automated adaptation based on the new image set.
    - Approval – approval of converted image set, structure set and plan.
- All steps are configurable per clinical indication. Plan generation protocols are used to specify strategies for image enhancement, segmentation, evaluation of dose estimate and replanning.

2.3 MULTI-METS PLANNING

- New tool for multi-mets photon planning that creates additional arc beams, selects targets to treat per beam, and sets collimator angles to minimize dose to healthy tissue.
- Rotational directions and beam order are set to ensure fast delivery.
- Requires license rayMultiMets.

2.4 DEEP LEARNING SEGMENTATION

- Deep learning segmentation now runs faster and visualizes progress in the patient views during segmentation.
- The release includes numerous new ROIs, refinements of some already existing ROIs, as well as increased stability towards different scan regions.
- The parotid gland, submandibular gland, and the thyroid gland have been refined through the inclusion of a larger cohort of patients, with a larger variation than was used before.
- The femoral head structure has been refined so that it more closely follows the boney limits. It can now also be used for female patients as well as for male patients.
- Spinal canal is more stable and can now handle all scan regions, solving a previous issue where it could struggle with pelvic cases.
- The four localization models previously used have been replaced with one model. This model has been made more stable for different scan regions solving several of the previous issues where selecting an ROI that was not in field of view, for example heart on a pelvic scan, could lead to a faulty, non-empty, segmentation.
- The 2024B release features a total of 53 new ROIs, which are listed in the table below.

Group	Regions of Interest
Neck lymph nodes	LN_Neck_IA, LN_Neck_IB_L, LN_Neck_IB_R, LN_Neck_II_L, LN_Neck_II_R, LN_Neck_III_L, LN_Neck_III_R, LN_Neck_IVA_L, LN_Neck_IVA_R, LN_Neck_IVB_L, LN_Neck_IVB_R, LN_Neck_VAB_L, LN_Neck_VAB_R, LN_Neck_VC_L, LN_Neck_VC_R, LN_Neck_VIA, LN_Neck_VIB, LN_Neck_VIIA_L, LN_Neck_VIIA_R, LN_Neck_VIIB_L, LN_Neck_VIIB_R
Brachial plexus and proxies	BrachialPlex_L, BrachialPlex_R, Musc_Scalene_Ant_L(BrachialPlex_proxy), Musc_Scalene_Ant_R(BrachialPlex_proxy), Musc_Scalene_Med_L(BrachialPlex_proxy), Musc_Scalene_Med_R(BrachialPlex_proxy)
Constrictor muscles	Cricopharyngeus, Musc_Constrict_I, Musc_Constrict_M, Musc_Constrict_S
Bronchial tree substructures	Bronchus_InterM, Bronchus_ Main_L, Bronchus_ Main_R, Carina
Vessels	A_Aorta_Arc, A_Aorta_Asc, A_Aorta_Desc, A_Brachiocephls, A_Carotid_Int_L, A_Carotid_Int_R, A_Carotid_L, A_Carotid_R, A_Subclavian_L, A_Subclavian_R, V_Brachioceph_L, V_Brachioceph_R, V_Jugular_Int_L, V_Jugular_Int_R, V_Subclavian_L, V_Subclavian_R, V_Venacava_I, V_Venacava_S

2.5 MACHINE LEARNING PLANNING

- The predicted machine learning dose for the beam set can now be inspected in the Plan evaluation module.
- It is now possible to select a tolerance table in the *New machine learning plan* dialog.

2.6 GENERAL SYSTEM IMPROVEMENTS

- Support for secondary acceptance levels for clinical goals.
  - A third state of clinical goal fulfillment has been introduced and clinical goals are now reported as *Fulfilled* (green), *Acceptable* (yellow) or *Not fulfilled* (orange).
  - Two acceptance levels define the clinical goal fulfillment, a primary acceptance level and an optional secondary acceptance level. A clinical goal is considered *Fulfilled* if its primary acceptance level is met and *Acceptable* if only its secondary acceptance level is met.
  - If a clinical goal has no secondary acceptance level, it will either be *Fulfilled* or *Not fulfilled*.
- Clinical goal descriptions now use short format when displayed in the GUI e.g., "Dmean >= 40 Gy" instead of "At least 40 Gy average dose". The long format is available as a tooltip.
- It is now faster to load planning modules – especially for cases with a high number of visualized ROIs.
- Support for DICOM data with larger pixel data range than before.
  - Previously, import was blocked if either the minimum pixel value of a PET or MR image set, or the minimum HU value of a CT image set was less than -32768 or the maximum pixel value of a PET or MR image set, or the maximum HU value of a CT image set was more than 32767. Such images can now be imported and used in RayStation.
  - This extended supported range removes the need for several existing import filters which rescale pixel data before import.
- Dose is now invalidated when dose computation settings are modified.
  - The *Compute dose* button is now disabled if a clinical dose computed with the latest dose engine version already exists.
- RayStorage improvements:
  - It is now possible to use the command line to move patients between data sources. This makes it possible to, for example, schedule movement of patients that have not been changed for 30 days to a secondary database.
  - The transfer screen in RayStorage now provides more options, including moving and copying to and from rsbak repositories.

2.6.1 Snapshots in reports

- The new snapshots functionality enables the user to take a screenshot of any part of the application window, add a title and a description, and include it in a treatment plan report.
- The *Snapshots* tab added to the left-hand panel displays all snapshots associated with the currently open treatment plan, organized into two lists: *Included in report* and *Excluded from report*. The snapshots can be moved between the lists. All snapshots added to the "included" list will be included when generating a treatment plan report, provided that the report template includes the snapshots module.

2.7 PATIENT DATA MANAGEMENT

- It is now possible to change the mass densities for the predefined levels in the CBCT to density table. Default densities are the same as in previous versions.

2.8 PATIENT MODELING

- It is now possible to add ROIs to a template in the *Structure template management* dialog. The options are to add a DLS ROI, a mapped ROI, a derived ROI or an empty ROI.
- It is now possible to use structure templates to copy or map ROIs from one image set to another. If an ROI in a template has initialization method *Mapping*, an image set from the patient can be selected when running the template and the ROI will be copied rigidly or mapped deformably from the selected image set to the new image set. It is also possible to run templates with mapped ROIs from protocols.
- In *Structure template management*, it is now possible to create a copy of a structure template and to change initialization for some types of ROIs, e.g. change which DLS model that should be used to initialize an ROI or edit how an ROI should be mapped using the template.
- The toolbar in the *Structure definition* module now has a more compact design.
- In the *Patient modeling* module, it is possible to select *Show as supine* in the visualization settings to always display patients as Supine, regardless of scanning position.
- A new algorithm used when creating field-of-view ROIs has been added. The new algorithm is able to detect the field-of-view in cases where the old algorithm was known to fail. The new algorithm will be used by default and the old algorithm has been made optional.
- In RayStation 2024B, the following template materials have been removed: Aluminum+, Aluminum2 Bone1, Bone+, Cartilage1 Bone2, Cartilage2 Bone1, LiF PE, LN10, PLA, PlasticAE C-552, PlasticBE B-100, PlasticTE A-150, RB2, SB5, Silicon [Si], Ti-6Al-4V, WT1. Existing plans will not be affected by this change.

2.9 IMPROVEMENTS TO IMAGE CONVERSION WORKFLOW

- The image conversion algorithms (Corrected CBCT and Virtual CT) can now also be used for regular CT images.
- Approval of converted image sets is simplified. Input data, such as the deformable registration, External ROI and field-of-view ROIs do not have to be approved.
- It is now possible to use an unapproved converted image set as planning image set via the GUI (previously only possible via scripting). It is also possible to unapprove converted image sets used in unapproved plans.
- When approving or unapproving a converted image set, dose values computed on the image set are no longer invalidated. Instead, the clinical status of each dose computed on the image set is automatically updated, considering the new approval status of the image set and all other factors that determine the clinical status of the dose.
- At plan and beam set approval: If the beam set to be approved is planned on a converted image set that is not yet approved, the plan approval will launch the *Approve converted image set* workflow in advance of launching the *Plan approval* workflow.

2.10 BRACHYTHERAPY PLANNING

- The toolbar in the Brachy planning module now has a more compact design.
- It is now possible to edit the effective length of a channel.
- It is now possible to import applicator models from XML files. The imported applicator models can be saved as structure templates for fast loading during planning. Additionally, user-defined structures can be added to the structure templates, e.g. evaluation points (A-point).
- Improved rotate and translate functionality for applicator models, allowing coupled transformations of source path and applicator model ROIs.

2.11 VIRTUAL SIMULATION

- It is now possible to commission a LINAC treatment machine for Virtual simulation use only. See *section 2.27.1 Photon beam commissioning on page 17*.

2.12 3D-CRT BEAM DESIGN

- The .decimal GRID block can be defined through a scriptable action. Dose computation has been validated for Elekta Agility and Varian TrueBeam.

2.13 PLAN OPTIMIZATION

- It is now possible to exclude beams from a co-optimized beam set. Excluded beams are not affected by the optimization, but the dose is a part of the beam set dose.

- Optimization with respect to segment MU is now supported for co-optimized beam sets.
- There was an issue where VMAT plans for wide targets, using a machine commissioned with Jaw movement rule *Per segment* (jaw tracking) and beam splitting strategy *Use multiple carriage groups* sometimes violated the *Maximum leaf out of carriage distance* constraint, resulting in one or many pauses during the delivery of an arc beam. This problem has now been resolved.

2.14 ROBUST OPTIMIZATION

- Optimization functions that refer to beam set + background dose can now be set as robust.
  - The background dose can be an imported dose, a dependent beam set or a dose computed in dose tracking.
  - The background dose is considered to be fixed (already delivered) during optimization, i.e. the background dose is summed to all scenario doses.
  - Robust functions on beam set + background are not supported in MCO.
  - Robust functions on beam set + background are not supported when using organ motion uncertainty (4D).
- Possibility to use a reduced number of scenarios for patient position and density uncertainty during robust optimization.
  - If a reduced set of patient shifts is checked, only scenarios with the nominal patient position and the extreme patient shifts along the axis directions are included.
  - If a reduced set of density shifts is checked, only scenarios with extreme density shifts are included.
- Improved UI when user defined patient shifts are used (set through scripting).

2.15 GENERAL PHOTON PLANNING

- For the new Hitachi LINAC OXRAY, it is possible to set the gimbal angles when a treatment plan is created.

2.16 TOMOTHERAPY/RADIXACT PLANNING

- The Tomo/Radixact optimization algorithm has been improved to better compensate for changes in the target geometry before an optimization is continued. This enables fast re-optimization of plans in response to anatomical changes.

2.17 CYBERKNIFE PLANNING

- The algorithm for optimizing MLC segments for CyberKnife plans has been improved. In previous releases, the segments could sometimes become unnecessarily large after continuing an optimization.

2.18 PROTON PENCIL BEAM SCANNING PLANNING

- The option to continue optimization using the spot dose cache is now available for Line Scanning. The related tools *Fine-tune*, *Reduce OAR dose* and *Dose brush* have also been enabled for Line Scanning.

2.19 LIGHT ION PENCIL BEAM SCANNING PLANNING

- The minimum and maximum (if present) spot metersets that are used during optimization will be automatically scaled by the fixed number of repaints per beam for a Toshiba carbon ion machine. During DICOM export, plan approval and report generation, a warning will be given if any spot weight is below the minimum spot meterset or above the maximum spot meterset, multiplied by the number of repaints per energy layer.

2.20 OCULAR PLANNING

- For ocular gaze treatments, it is again possible to see the density distribution used for dose computation without having computed the dose, in the same way as in RayStation 2023B and earlier.

2.21 PLAN EVALUATION

- Evaluation doses are now always computed according to their own dose computation settings, not according to the current nominal beam set dose computation settings. This will affect re-computation of invalidated evaluation doses if the dose computation settings have been changed for the nominal beam set. The dose computation settings can be edited through scripting.
- RBE model and dose computation settings are now displayed in the dose tooltip.

2.22 ROBUST EVALUATION

- Beam dose values are no longer stored for the robust scenario doses for memory saving purposes. It is possible to set the flag *FractionDose.InputSettingsForFinalDose.StoreBeamDoseValues* to *True* through scripting if beam dose values are desired.

2.23 DOSE TRACKING

- The *Clinical goals* table now has the planned vs delivered dose in separate columns instead of in separate rows, similar to the Plan evaluation module.
- It is now possible to use structure templates to copy or map ROIs from one image set to another (see *section 2.8 Patient modeling on page 12*).
- A new algorithm for creation of field-of-view ROIs is able to detect the field-of-view in cases where the old algorithm was known to fail (see *section 2.8 Patient modeling on page 12*).
- Multiple improvements to image conversion (see *section 2.9 Improvements to image conversion workflow on page 13*).
- Beam dose values are no longer stored for the Dose tracking fraction doses for memory saving purposes. It is possible to set the flag *FractionDose.InputSettingsForFinalDose.StoreBeamDoseValues* to *True* through scripting if beam dose values are desired.

2.24 ADAPTIVE REPLANNING

- New separate module for automated adaptive replanning (see *section 2.2 Automated adaptive replanning on page 9*).
- Slightly new layout for the *Create adapted plan* dialog (background dose source and adapted starting fraction is now specified first).
- New default naming convention for adapted plans and their beam sets based on the adapted fraction number.
- It is now possible to use structure templates to copy or map ROIs from one image set to another (see *section 2.8 Patient modeling on page 12*).
- A new algorithm for creation of field-of-view ROIs is able to detect the field-of-view in cases where the old algorithm was known to fail (see *section 2.8 Patient modeling on page 12*).
- Multiple improvements to image conversion (see *section 2.9 Improvements to image conversion workflow on page 13*).

2.25 DICOM

- A new version of the RayStation Storage SCP supports automatic import of DICOM data sent to the SSCP. It is also possible to configure a customizable RayStation script to automatically run after import. This allows for automation of any scriptable workflow such as deep learning segmentation or automatic planning.
- It is now possible to configure the order in which treatment beams and setup beams are exported in the Beam Sequence (300A,00B0) and Ion Beam Sequence (300A,03A2). This configuration is done when commissioning a machine. Some systems require the treatment beams to come first, others require that the setup beams come first.

2.26 SCRIPTING

- A scripting method *Examination.IsClinical()* has been added.
- A scripting method *DoseDistribution.HasClinicalDose()* has been added. The old way of reading the clinical status of a dose through *DoseDistribution.DoseValues.IsClinical* has been removed.
- The arguments *DoseAlgorithm* and *ComputeBeamDoses* for *ComputeDoseAction()* have been removed. Instead, the properties *FractionDose.InputSettingsForFinalDose.DoseAlgorithm* and *FractionDose.InputSettingsForFinalDose.StoreBeamDoseValues* should be populated with desired values before the call to *ComputeDoseAction()*.
- The introduction of secondary acceptance levels for clinical goals affects scripting methods used for clinical goal evaluation. The methods return *true* if a clinical goal is fulfilled or *acceptable* and *false* otherwise. The following methods are affected:
  - *EvaluateClinicalGoal*
  - *EvaluateClinicalGoalForAccumulatedDose*
  - *EvaluateClinicalGoalForEvaluationDose*
  - *EvaluateClinicalGoalForVoxelwiseWorstTotalDose*
- The scripting method *GetPercentageOfPassedScenarios*, used for robust evaluation, has been replaced by two new methods following the introduction of secondary acceptance levels for clinical goals.
  - *GetPercentageOfFulfilledScenarios*
  - *GetPercentageOfAcceptableScenarios*

2.27 RAYPHYSICS

2.27.1 Photon beam commissioning

- It is now possible to import open and standard wedge photon dose curves on W2CAD .asc format version 02.
- It is now possible to commission a LINAC treatment machine for virtual simulation use only, which allows for the virtual simulation use case without physics licenses. Such a machine contains no beam models, and it is therefore not possible to use it for dose computation.
- Template machine is added for OXRAY: 'T_OXRAY'
- Template machine is updated for TrueBeam: 'T_TrueBeam'

2.27.2 Electron beam commissioning

- Template machine is updated for TrueBeam: 'T_TrueBeam'

2.27.3 Ion beam commissioning

- Pencil Beam Scanning and Line Scanning beam models where spot profile beam data is acquired at several snout positions can now be visualized in RayPhysics. It is also possible to compute dose curves for different snout positions. There are also various improvements to the *Spot profiles* tab.

2.28 RAYSTATION 2024B DOSE ENGINE UPDATES

The changes to the dose engines for RayStation 2024B are listed below.

Dose engine	2024A	2024B	Requires recommissioning	Dose effect[i]	Comment
All	-	-	-	Negligible	Opened up for import of image sets which have higher pixels values than was previously allowed, i.e., densities used for dose computation can now be higher than previously in areas of the image set with high density, e.g., areas with metal artifacts that do not have a material override.
Photon Collapsed Cone	5.9	5.10	No	Negligible	
Photon Monte Carlo	3.1	3.2	No	Negligible	
Electron Monte Carlo	5.1	5.2	No	Negligible	
Proton PBS Monte Carlo	5.6	5.7	No	Negligible	
Proton PBS Pencil Beam	6.6	6.7	No	Negligible	
Proton US/DS/ Wobbling Pencil Beam	4.11	4.12	No	Negligible	

Dose engine	2024A	2024B	Requires recommis-sioning	Dose effect[i]	Comment
Carbon PBS Pencil Beam	7.0	7.1	No	Negligible	
Brachy TG43	1.5	1.6	No	Negligible	

i The dose effect (Negligible/Minor/Major) refers to the effect when recommissioning of the machine model is not performed. After successful recommissioning the dose changes should be minor.

2.29 IMAGE CONVERSION ALGORITHM UPDATES

The changes to the image conversion algorithms for RayStation 2024B are listed below.

Conversion algorithm	2024A	2024B	Dose effect	Comment
Corrected CBCT	1.3	1.4	Negligible	Minor changes in the created image set HU values may occur for image sets with a large pixel value range due to changed handling of the highest pixel values. Added support for CT image sets.
Virtual CT	1.3	1.4	Negligible	Minor changes in the created image set HU values may occur for image sets with a large pixel value range due to changed handling of the highest pixel values. Added support for CT image sets.

2.30 CHANGED BEHAVIOR OF PREVIOUSLY RELEASED FUNCTIONALITY

- Note that RayStation 11A introduced some changes regarding prescriptions. This information is important if upgrading from a RayStation version earlier than 11A:
  - Prescriptions will always prescribe dose for each beam set separately. Prescriptions defined in RayStation versions prior to 11A relating to beam set + background dose are obsolete. Beam sets with such prescriptions cannot be approved and the prescription will not be included when the beam set is DICOM exported.
  - Prescriptions that are set using a plan generation protocol will now always relate to the beam set dose only. Make sure to review existing plan generation protocols when upgrading.
  - Prescription percentage is no longer included in exported prescription dose levels. In RayStation versions prior to 11A, the Prescription percentage defined in RayStation was included in the exported Target Prescription Dose. This has been changed so that only the

Prescribed dose defined in RayStation is exported as Target Prescription Dose. This change also affects exported nominal dose contributions.

- In RayStation versions prior to 11A, the Dose Reference UID exported in RayStation plans was based on the SOP Instance UID of the RT Plan/RT Ion Plan. This has been changed so that different prescriptions can have the same Dose Reference UID. Because of this change, the Dose Reference UID of plans exported prior to 11A has been updated so that if the plan is re-exported a different value will be used.

- Note that RayStation 11A introduced some changes regarding Setup imaging systems. This information is important if upgrading from a RayStation version earlier than 11A:

  - A Setup imaging system (in earlier versions called Setup imaging device) can now have one or several Setup imagers. This enables multiple setup DRRs for treatment beams as well as a separate identifier name per setup imager.

    + Setup imagers can be gantry-mounted or fixed.

    + Each setup imager has a unique name which is shown in its corresponding DRR view and is exported as a DICOM-RT Image.

    + A beam using a setup imaging system with multiple imagers will get multiple DRRs, one for each imager. This is available for both setup beams and treatment beams.

- Note that RayStation 8B introduced handling of effective dose (RBE dose) for protons. This information is important for proton users if upgrading from a RayStation version earlier than 8B:

  - Existing proton machines in the system will be converted to RBE type, that is, it is assumed that a constant factor of 1.1 has been used. Contact RaySearch if this is not valid for any machine in the database.

  - Import of RayStation RT Ion Plan and RT Dose of modality proton and with dose type PHYSICAL that was exported from RayStation versions earlier than 8B will be treated as RBE level if the machine name in the RT Ion Plan refers to an existing RBE machine.

  - RT Dose of dose type PHYSICAL from other systems or from RayStation versions earlier than 8B with a machine that does not have the RBE included in the beam model will be imported as in earlier versions and will not be displayed as RBE dose in RayStation. The same applies if the referenced machine does not exist in the database. It is the responsibility of the user to know if the dose should be treated as physical or as RBE/photon equivalent. However, if such a dose is used as background dose in subsequent planning, it will be treated as an effective dose.

  For more details, refer to *Appendix A Effective dose for protons*.

- Note that RayStation 11B introduced changes in the dose statistics calculations. This means that small differences in evaluated dose statistics are expected when comparing to a prior version.

This affects:

- DVHs
- Dose statistics
- Clinical goals
- Prescription evaluation
- Optimization objective values
- Fetching dose statistics measures via scripting

This change also applies to approved beam sets and plans, meaning that, for example, prescription and clinical goals fulfillment may change when opening a previously approved beam set or plan from a RayStation version prior to 11B.

The dose statistics accuracy improvement is more noticeable with increasing dose range (difference between minimum and maximum dose within an ROI), and only minor differences are expected for ROIs with dose ranges smaller than 100 Gy. The updated dose statistics no longer interpolates values for Dose at volume, $D(v)$, and Volume at dose, $V(d)$. For $D(v)$, the minimum dose received by the accumulated volume v is instead returned. For $V(d)$, the accumulated volume that receives at least the dose d is returned. When the number of voxels within an ROI is small, the discretization of the volume will become apparent in the resulting dose statistics. Multiple dose statistics measures (e.g., D5 and D2) may get the same value when there are steep dose gradients within the ROI, and similarly, the dose ranges lacking volume will appear as horizontal steps in the DVH.

- Note that RayStation 2024A introduces the possibility to associate a clinical goal to either the beam set dose or the plan dose. This information regarding existing plans and templates with clinical goals is important if upgrading from a RayStation version earlier than 2024A:
  - Physical clinical goals in single beam set plans will now be automatically associated with that beam set.
  - For plans with multiple beam sets, physical clinical goals will be duplicated to ensure all possible associations within the plan. For example, a plan with two beam sets will yield three corresponding copies of each clinical goal: one for the plan and one for each of the two beam sets.
  - Clinical goals defined in templates will be assigned to beam set with name 'BeamSet1'. Users who plan with multiple beam sets are advised to update their templates with the correct association and beam set name. Pay special attention to templates used in protocols. Beam set names stored in templates should match a beam set created in the protocol.
- Note that RayStation 2024B introduces secondary acceptance levels for clinical goals. It is important to note how this affects existing methods for clinical goal evaluation in scripting. When scripting is used to evaluate clinical goals with secondary acceptance levels, the methods

will compare the clinical goal value with the secondary acceptance level and report fulfillment based on that. In other words, the methods will return *true* if a clinical goal is fulfilled (green), or *acceptable* (yellow) and *false* otherwise.

- For SMLC plans without optimization constraints, handling of leaf position bounds when continuing an optimization previously depended on whether intermediate dose was selected or not. The handling for the case with no intermediate dose has now been modified so that it is the same as when intermediate dose is selected. This typically affects the results for this type of optimization. Changes compared to previous RayStation versions are expected to be small.
- The *Smart angles* algorithm for Conformal Arc has been modified to use a more accurate cost function when determining the optimal angle. It now accounts for closed leaf pairs that cannot be hidden behind the x-jaws.
- Function values are no longer automatically computed after running *Scale dose*.
- For Tomo/Radixact plans, the algorithm for positioning jaws has been improved. This will lead to slightly different jaw positions around target edges and for small targets.
- The *D* icon on DLS ROIs in the ROI list was previously shown if the geometry was the same as the deep learning segmentation model created. Now, the *D* icon is always shown for ROIs created by DLS regardless of if the geometry has changed or not.
- Previously, ROIs/POIs from the converted image set were shown in the views in the *Approve converted image set* dialog. Now, no ROIs/POIs are shown in any of the views in the dialog.

2.31 RESOLVED FIELD SAFETY NOTICES (FSNS)

The following FSNs (Field Safety Notices) are resolved in RayStation 2024B, as compared to RayStation 2024A.

- FSN 130646
- FSN 133261

2.32 NEW AND SIGNIFICANTLY UPDATED WARNINGS

For the complete list of warnings, see *RSL-D-RS-2024B-IFU, RayStation 2024B Instructions for Use*.

2.32.1 New warnings

WARNING!

Ensure that the .decimal GRID block contour in RayStation matches the physical block. The CreateDotDecimalBlockContour method creates the .decimal GRID block contour for the current collimator angle. After creation the .decimal GRID block is handled as a regular photon block in RayStation and does not rotate with the collimator. If the collimator angle is changed the block contour will no longer correspond to the physical .decimal GRID block which rotates with the collimator.

Since the .decimal GRID block is not manufactured based on a block contour exported from RayStation, it is crucial to ensure that the block contour in RayStation matches the physical block and that the .decimal GRID block contour is not changed unintentionally by changing the collimator angle or other manual editing. To ensure that the block contour has not been unintentionally changed, the CreateDotDecimalBlockContour method can be called again as a last step before final dose computation and plan approval.

(936115)

WARNING!

Review warnings when using automatic import and segmentation workflow after automatic export to another system. Warnings generated during automatic import are displayed when opening the patient for the first time. If the automatic import and segmentation workflow is used to automatically export the created structures without opening the patient in RayStation, the exported structures must be reviewed in the consuming system. Any warnings generated at import are also accessible through scripting.

(932309)

WARNING!

Beams with gimbal angle. For a LINAC that is set up to support gimbal planning it is possible to set gimbal pan and/or gimbal tilt angle for a treatment beam. DRRs, physical depth and water equivalent depth are computed in the beam direction/to the gimbal adjusted virtual isocenter (i.e., including gimbal angles). SSD is reported to the beam/machine isocenter (no gimbal angles applied).

A DRR generated for a beam with non-zero gimbal angles is not suitable for patient setup, as it is not directed at machine isocenter but the gimbal adjusted virtual isocenter.

(937534)

WARNING!

Review channel lengths. The inner and effective channel lengths are critical values communicated directly to the afterloader for the execution of the treatment plan. It is imperative to recognize that any discrepancy in the channel lengths may not be detected by the machine. Errors in these values can result in significant deviations from the intended treatment.

When channel lengths are edited during treatment planning, it is essential to confirm that all edited lengths accurately reflect the intended treatment setup prior to the final approval and delivery of the treatment plan.

(936234)

WARNING!

Save shall be avoided in background scripts. A background script is executed by the computation service. The patient state is automatically saved after the script has been executed.

Crashes during the script execution will automatically re-run the script. If the script includes saves, the script has to make sure that repeated retries will not create unwanted states. Domain model rules still apply.

If possible, avoid explicit save of the patient in a background script.

(934662)

WARNING!

A background script should avoid generating output that requires user interaction. A background script has no means of returning the output of the script to the user. The exception are scripts triggered from RayCare where the output information is sent to RayCare for visualization.

A background script should avoid producing output that the user should react upon.

(934663)

WARNING!

The predicted machine learning dose shall not be used for making clinical decisions. The predicted machine learning dose is only visualized to provide the user with transparency into the output of the machine learning model.

(936842)

WARNING!

Review model data sheet prior to clinical use of machine learning model. Prior to clinical use of a machine learning model, the user must review the associated model data sheet to understand model limitations and intended usage.

(24213)

2.32.2 Significantly updated warnings

WARNING!

Bolus ROIs need to be assigned to beam(s). Bolus ROIs are regarded as beam properties. In order for a bolus ROI to be used for radiation transport and dose computation for a certain beam, it must be assigned to that beam. If a bolus is to be used for all beams, it must be assigned to all beams individually. A bolus which is not assigned to any beam in a plan is not going to contribute to the dose computation at all.

A bolus ROI assigned to a beam will be:

- shown with solid line style in the 2D patient views,
- shown in the 3D patient view and
- included in the Material patient view when beam dose for the corresponding beam is selected.

(5347)

WARNING!

Review applicator models. Users are strongly advised to adhere to industry standards for quality assurance of brachytherapy applicators and treatment planning. This includes performing dosimetric verification using methods such as gafchromic film measurements, as recommended by the American Association of Physicists in Medicine (AAPM) in *Code of practice for brachytherapy physics: Report of the AAPM Radiation Therapy Committee Task Group No. 56* and in the *AAPM Medical Physics Practice Guideline 13.a*.

The user is advised to create a structure template including the applicator structures. After completing appropriate QA checks, it is crucial to approve the template to ensure that the applicator structures do not undergo unintended changes over time. During the treatment planning process, users should only use structures from these approved templates to maintain consistency and accuracy in treatment delivery.

(726082)

3 KNOWN ISSUES RELATED TO PATIENT SAFETY

There are no known issues related to patient safety in RayStation 2024B.

Note: *Additional release notes may potentially be distributed shortly after installation.*

4 OTHER KNOWN ISSUES

4.1 GENERAL

The auto recovery feature does not handle all types of crashes

The auto recovery feature does not handle all types of crashes and sometimes when trying to recover from a crash RayStation will show an error message with the text "Unfortunately auto recovery does not work for this case yet". If RayStation crashes during auto recovery, the auto recovery screen will pop up next time RayStation is started. If this is the case, discard the changes or try to apply a limited number of actions to prevent RayStation from crashing.

(144699)

Limitations when using RayStation with large image set

RayStation now supports import of large image sets (>2GB), but some functionality will be slow or cause crashes when using such large image sets:

- Smart brush/Smart contour/2D region growing are slow when a new slice is loaded
- Hybrid deformable registration might run out of memory for large image sets
- Biomechanical deformable registration might crash for large image sets
- Automated Breast Planning does not work with large image sets
- Creating large ROIs with gray-level thresholding might cause a crash

(144212)

Limitations when using multiple image sets in a treatment plan

Plan total dose is not available for plans with multiple beam sets that have different planning image sets. Without plan dose it is not possible to:

- Approve the plan
- Generate plan report
- Enable the plan for dose tracking
- Use the plan in adaptive replanning

(341059)

Slight inconsistency in dose display

The following applies to all patient views where dose can be viewed on a patient image slice. If a slice is positioned exactly on the border between two voxels, and dose interpolation is disabled, the dose value presented in the view by the "Dose: XX Gy" annotation can differ from the actual presented color, with regards to the dose color table.

This is caused by the text value and the rendered dose color being fetched from different voxels. Both values are essentially correct, but they are not consistent.

The same can occur in the dose difference view, where the difference might seem larger than it actually is, because of neighboring voxels being compared.

(284619)

Cut plane indicators are not displayed in 2D patient views

The cut planes, used to limit the CT data used for computing a DRR, are not visualized in regular 2D patient views. To be able to view and use cut planes, use the DRR settings window.

(146375)

No warning is given when deleting a case containing approved plans

When a patient containing an approved plan is selected for deletion, the user will be notified and given the opportunity to cancel the deletion. However, if a case containing an approved plan is selected for deletion for a patient with multiple cases, no warning will be given to the user that an approved plan is about to be deleted.

(770318)

4.2 IMPORT, EXPORT AND PLAN REPORTS

Import of approved plan causes all existing ROIs to be approved

When importing an approved plan to a patient with existing unapproved ROIs, the existing ROIs can become automatically approved. If this occurs, a UI message is given at import stating that the plan approval status will be transferred to the RTStruct. If importing via scripting, this information is given in the import log.

336266

Laser export not possible for decubitus patients

Using the laser export functionality in the Virtual simulation module with a decubitus patient causes RayStation to crash.

(331880)

RayStation sometimes reports a successful TomoTherapy plan export as failed

When sending a RayStation TomoTherapy plan to iDMS via RayGateway, there is a timeout in the connection between RayStation and RayGateway after 10 minutes. If the transfer is still ongoing when the timeout starts, RayStation will report a failed plan export even though the transfer is still in progress.

If this happens, review the RayGateway log to determine if the transfer was successful or not.

338918

Report Templates must be upgraded after upgrade to RayStation 2024B

The upgrade to RayStation 2024B requires upgrade of all Report Templates. Also note that if a Report Template from an older version is added using Clinic Settings, this template must be upgraded to be used for report generation.

Report Templates are upgraded using the Report Designer. Export the Report Template from Clinic Settings and open it in the Report Designer. Save the upgraded Report Template and add it in Clinic Settings. Do not forget to delete the old version of the Report Template.

(138338)

4.3 PATIENT MODELING

Memory crashes can occur when running large hybrid deformable registration computations on GPU

GPU computation of deformable registration on large cases can result in memory related crashes when using the highest grid resolution. The occurrence depends on the GPU specification and the grid size.

(69150)

4.4 BRACHYTHERAPY PLANNING

Mismatch of planned number of fractions and prescription between RayStation and SagiNova

There is a mismatch in the interpretation of the DICOM RT Plan attributes *Planned number of fractions* (300A, 0078) and *Target prescription dose* (300A,0026) in RayStation compared to the brachytherapy afterloading system SagiNova. This applies specifically to SagiNova versions 2.1.4.0 or earlier. If the clinic is using a version later that 2.1.4.0, contact customer support to verify whether the issue persists.

When exporting plans from RayStation:

- The target prescription dose is exported as the prescription dose per fraction multiplied by the number of fractions of the beam set.
- The planned number of fractions is exported as the number of fractions for the beam set.

When importing plans into SagiNova for treatment delivery:

- The prescription is interpreted as the prescription dose per fraction.
- The number of fractions is interpreted as the total number of fractions, including fractions for any previously delivered plans.

Possible consequences are:

- At treatment delivery, what is displayed as prescription per fraction on the SagiNova console is actually the total prescription dose for all fractions.
- It might not be possible to deliver more than one plan for each patient.

Consult with SagiNova application specialists for appropriate solutions.

(285641)

Brachy Monte Carlo number of histories

The number of histories used to compute a brachy Monte Carlo dose distribution is not displayed in the patient views. This information can be retrieved through scripting. It is the responsibility of the user to ensure that a Monte Carlo dose is computed with a sufficient number of histories to reach an acceptable statistical uncertainty.

(1043893)

DICOM connectivity issue with Oncentra Brachy related to measured source paths

An issue has been identified affecting the DICOM import of measured applicator model source paths into Oncentra Brachy.

When importing an applicator model from an XML file into RayStation, it is possible to import measured source paths. These measured source paths are characterized by absolute 3D positions of the source points that are not equidistant. The measured source paths are imported from the XML files as described in *RSL-D-RS-2024B-BAMDS, RayStation 2024B Brachy Applicator Model Data Specification*, and the resulting 3D source positions in RayStation correctly represent the source paths provided in the XML files. The 3D source positions are also correct in DICOM exports from RayStation. However, when importing the file into Oncentra Brachy the measured source paths undergo a shift, causing a discrepancy between the absolute source positions in Oncentra Brachy and RayStation. This could mean that a dose distribution recomputed in Oncentra does not match the corresponding dose distribution calculated in RayStation.

The dose distribution computed by RayStation is correct, provided that the applicator is correctly modeled in RayStation. As noted in the *RSL-D-RS-2024B-IFU, RayStation 2024B Instructions for Use* (see warning 726082, Review applicator models), users are strongly advised to adhere to industry standards on applicator model quality assurance to ensure that the applicator is accurately represented in RayStation.

This issue is specific to measured source paths within applicator models and does not affect source paths reconstructed by other methods.

(1043992)

4.5 PLAN DESIGN AND 3D-CRT BEAM DESIGN

Center beam in field and collimator rotation may not keep the desired beam openings for certain MLCs

Center beam in field and collimator rotation in combination with "Keep edited opening" might expand the opening. Review apertures after use and if possible use a collimator rotation state with "Auto conform".

(144701)

4.6 PLAN OPTIMIZATION

No feasibility check of max leaf speed performed for DMLC beams after dose scaling

DMLC plans that result from an optimization are feasible with respect to all machine constraints. However, manual rescaling of dose (MU) after optimization may result in violation of the maximum leaf speed depending on the dose rate used during treatment delivery.

(138830)

Add MCO function not working correctly in conjunction with background dose

The reference dose function created when clicking the *Add MCO function* button will for a dependent beam set not include the background dose. RayStation will attempt to recreate the navigated beam set dose instead of the navigated beam set + background dose, if such a reference dose function is included in the optimization. This will typically result in a lower optimized dose than intended. Using the *Add MCO function* button is therefore not recommended for dependent beam sets. Creation of a deliverable plan in the MCO module is unaffected by this issue.

(932475)

4.7 CYBERKNIFE PLANNING

Verifying deliverability of CyberKnife plans

CyberKnife plans created in RayStation may, for about 1% of the cases, fail the deliverability validation. Such plans will not be deliverable. The affected beam angles will be identified by the deliverability checks that are run at plan approval and plan export.

To check if a plan is affected by this issue before approval, the script method `beam_set.CheckCyberKnifeDeliverability()` can be run. The affected segments can be manually removed before running a continued optimization for the last adjustments.

(344672)

The spine tracking grid smaller in Accuray TDC than the grid displayed in RayStation

The spine tracking grid used and displayed in Accuray TDC (Treatment Delivery Console) for treatment delivery setup will be around 80% smaller than the grid visualized in RayStation. In RayStation, make sure to assign the grid a margin around the intended setup area. Note that the grid size is editable in Accuray TDC at delivery.

(933437)

4.8 TREATMENT DELIVERY

Mixed beam sets in plan fraction schedule

For plans with multiple beam sets where the plan fraction schedule has been manually edited for a subsequent beam set, a change to the number of fractions for a preceding beam set will result in a faulty fraction schedule where beam sets are no longer planned in sequence. This can lead to issues in dose tracking and adaptive replanning. To prevent this, always reset the plan fraction schedule to default before changing number of fractions for beam sets in a multi beam set plan after the fractionation pattern has been manually edited.

(331775)

4.9 AUTOMATED PLANNING

Incorrect Beam on interval might be set back without notification

In the Plan Explorer Edit Exploration Plan dialog, when editing the Beam on interval value in the Beam Optimization Settings tab, the value will change back to the previous value without notice if the entered value is out of range. This could easily be missed, for example if the dialog is closed directly after entering an incorrect value. The Beam on interval value is only applicable for VMAT treatment machines commissioned for burst mode (mArc).

(144086)

4.10 BIOLOGICAL EVALUATION AND OPTIMIZATION

Undo/redo invalidates response curves in the Biological Evaluation module

In the Biological Evaluation module, the response curves are removed on undo/redo. Recompute the function values to restore the response curves.

(138536)

Limitation when evaluating biological clinical goals with time dependent effects in the Dose tracking module

The Dose tracking module supports evaluation of biological clinical goals with time dependent effects (repair and repopulation). Input to this evaluation is the time of treatment of the fractions in the dose tracking treatment course. However, the time of treatment for the fractions is not displayed in the Dose tracking module which makes it difficult for the user to know exactly what the basis for the evaluation is. When initializing dose tracking from a treatment plan, the time of treatment is copied from the plan to the dose tracking treatment course. However, when manually adding or removing fractions the time of treatment might be different from the intended fractionation. Time of treatment for the dose tracking fraction is currently only accessible via scripting. The user must be aware of this limitation when evaluating biological clinical goals with time dependent effects in the Dose tracking module.

(722865)

4.11 RAYPHYSICS

Updated recommendations for detector height usage

Between RayStation 11A and RayStation 11B, recommendations on the usage of detector height and depth offset for depth dose curves have been updated. If the previous recommendations were followed, the modeling of the build-up region for photon beam models could lead to surface dose overestimation in computed 3D dose. When upgrading to a RayStation version newer than 11A, it is recommended to review and, if needed, update photon beam models with respect to the new recommendations. Refer to section *Detector height and depth offset* in *RSL-D-RS-2024B-REF, RayStation 2024B Reference Manual*, section *Depth offset and detector height* in *RSL-D-RS-2024B-RPHY, RayStation 2024B RayPhysics Manual* and *RSL-D-RS-2024B-BCDS, RayStation 2024B Beam Commissioning Data Specification* for information about the new recommendations.

(410561)

4.12 SCRIPTING

Limitations regarding scripted reference functions

It is not possible to approve a beam set that includes a scripted reference dose function referencing an unlocked dose. This will lead to a crash. Also, approving a beam set that includes a scripted reference dose function referencing a locked dose, and consecutively unlocking the referenced dose will lead to a crash.

If a scripted reference dose function refers to an unlocked dose, there will be no notifications if the referenced dose is changed or removed. Finally, there is no guarantee when upgrading to new versions of RayStation that upgrades of optimization problems including scripted reference dose functions will retain the dose references.

(285544)

A EFFECTIVE DOSE FOR PROTONS

A.1 BACKGROUND

Starting with RayStation 8B the effective dose of proton treatments is treated explicitly, either by including a constant factor in the absolute dosimetry in the machine model or by combining a machine model based on physical dose in the absolute dosimetry with a constant factor RBE model. When upgrading from a RayStation version prior to RayStation 8B to RayStation 8B or later, all existing machine models in the database will be assumed to have been modeled with a constant factor of 1.1 in the absolute dosimetry to take the relative biological effects of protons into account. Contact RaySearch support if this is not valid for any machine in the database.

A.2 DESCRIPTION

- The RBE factor can either be included in the machine model (as was the standard workflow in RayStation versions prior to 8B) or be set in an RBE model.
  - If the RBE factor is included in the machine model, it is assumed to be 1.1. These machines are referred to as 'RBE'.
  - A clinical RBE model with factor 1.1 is included in every proton RayStation package. This is to be combined with machine models based on physical dose. These machines are referred to as 'PHY'.
  - For other constant factors than 1.1, the user needs to specify and commission a new RBE model in RayBiology. This option can only be used for PHY machines.
- **All existing proton machines in the system will be converted to dose type RBE, where it is assumed that a constant factor of 1.1 has been used to scale absolute dosimetry measurements. Correspondingly, the dose in all existing plans will be converted to RBE dose.**
- Display of RBE/PHY for PHY machine in the RayStation modules Plan design, Plan optimization and Plan evaluation.
  - Possible to toggle between physical and RBE dose in these modules.
  - Possible to view the RBE factor in the Difference view in Plan evaluation.
- For RBE machines, the only existing dose object is RBE dose. For PHY machines, RBE dose is the primary dose in all modules with the following exceptions:

  - Display of Beam Dose Specification Points (BDSP) will be in physical dose.
  - All doses in the QA preparation module will be in physical dose.

- DICOM import:
  - Import of RayStation RtIonPlan and RtDose of modality proton and with dose type PHYSICAL from earlier versions of RayStation than RayStation 8B will be treated as RBE dose if the machine name in the RtIonPlan refers to an existing machine with RBE included in the model.
  - RtDose of dose type PHYSICAL from other systems or from RayStation versions prior to 8B with a machine that does not have the RBE included in the beam model will be imported as in earlier versions and will not be displayed as RBE dose in RayStation. The same applies if the referenced machine does not exist in the database. It is the responsibility of the user to know if the dose should be treated as physical or RBE/photon equivalent. However, if such a dose is used as background dose in subsequent planning, it will be treated as an effective dose.

  Note: *Plans for machines from Mitsubishi Electric Co follow different rules and the behavior has not been changed from versions prior to RayStation 8B.*

- DICOM export:
  - Treatment plans and QA plans for proton machines with dose type RBE (changed behavior compared to RayStation versions prior to 8B where all proton doses were exported as PHYSICAL):
    + Only EFFECTIVE RT Dose elements will be exported.
    + BDSP in RT Plan elements will be exported as EFFECTIVE.
  - Treatment plans for machines with dose type PHY:
    + Both EFFECTIVE and PHYSICAL RT Dose elements will be exported.
    + BDSP in RT Plan elements will be exported as PHYSICAL.
  - QA plans for machines with dose type PHY:
    + Only PHYSICAL RT Dose elements will be exported.
    + BDSP in RT Plan elements will be exported as PHYSICAL.

  Note: *Plans for machines from Mitsubishi Electric Co follow different rules and the behavior has not been changed from versions prior to RayStation 8B.*

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