Considerations in Designing a Commissioning and QA protocol for HyperArc™

Version 1.0

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Introduction

HyperArc™ high-definition radiotherapy is a treatment solution for delivery of high doses of radiation to one or more targets within the brain. The solution includes assisted treatment planning and automated delivery on the machine. HyperArc uses co-planar and non-coplanar arcs optimized to treat multiple targets with a single isocenter.

This document provides considerations in designing a commissioning and QA protocol for early adopters of the HyperArc treatment solution based on the experience to date. The primary audience for this document will be clinical physicists responsible for the implementation and ongoing quality assurance of a HyperArc SRS program. This article is not intended to be complete, authoritative, or appropriate for all specific circumstances. Areas for refinement and improvement may be identified by the users, based on previous experience and data accumulated over time; however, this document will not be updated. Other approaches and additional or different steps may satisfy a user's QA needs. Users are encouraged to refer to official documentation and labelling for their medical devices as well as peer-reviewed publications for guidance. This document is primarily based on the work of one USA-based institution, The University of Alabama at Birmingham, in collaboration with Varian, and guidance from additional resource documents [1,2]:

Users in other geographic locations should review similar reports from their respective professional and scientific societies when implementing HyperArc™. This document does not include considerations of QA and standards of practice for incorporation of other imaging modalities, most notably MR, for target definition. Physicists should refer to guidance from professional and scientific societies, such as The American Association of Physicists in Medicine Report No. 132 - Use of image registration and fusion algorithms and techniques in radiotherapy: Report of the AAPM Radiation Therapy Committee Task Group No. 132, when incorporating other imaging modalities into a HyperArc™ program.

Lastly, the contributors are providing this document as a courtesy, and are not to be held responsible for any omissions, errors, etc. in the document.

Commissioning of the algorithms in Eclipse TPS for HyperArc:

1) Configuration of AAA and/or Acuros® XB photon dose calculation algorithm:

Beam configuration should follow the guidance given in the Eclipse™ Photon and Electron Algorithms Reference Guide, V15.5 and newer at www.myvarian.com A single beam model is expected to produce accurate results for all field sizes. There is no need to create separate models for the calculation of small and large field sizes. Refer to literature for more discussion on small fields in the photon beam source model. (T. Torsti, L. Korhonen, V. Petäjä: Using Varian Photon Beam Source Model for Dose Calculation of Small Fields. *Clinical Perspectives*, Varian Medical Systems, September 2013).

Recommended Measurements for Open Beam:

Refer to the Eclipse Photon and Electron Algorithms Reference Guide for specific measurement requirements for commissioning an open beam. General considerations include:

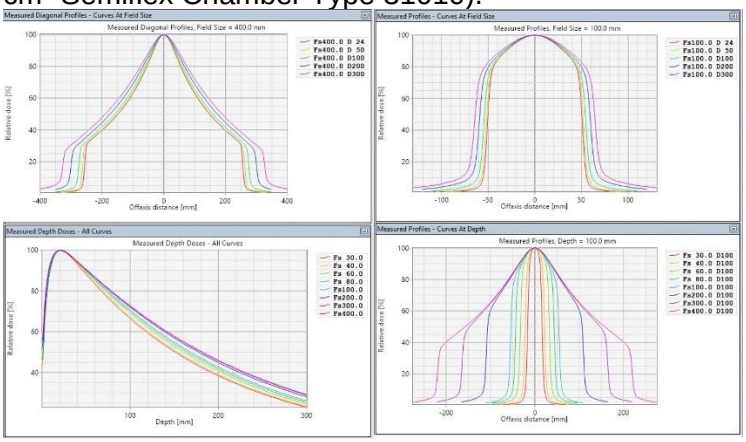
- Depth dose curves and profiles from 3×3 cm^2 up to maximum field size deliverable with the machine (for example 40×40 cm^2). The measurement set must contain field sizes at least up to 10×10 cm^2.
- Inclusion of measurements for smaller field sizes than 3×3 cm^2 does not have a significant impact on the calculated beam data parameters. The beam model should be accurate even though the measurement data do not contain very small field sizes (e.g. 1×1 cm^2 and 2×2 cm^2). Furthermore, depth dose curve and profile measurements for field sizes smaller than 2×2 cm^2 are ignored by the configuration program.
- Output factors from 3×3 cm^2 up to the maximum field size deliverable with the machine. Output factors for field sizes 1×1 cm^2 and 2×2 cm^2 can be included, if desired. These measurements will not affect the calculation results for small MLC collimated fields in treatment units where the MLC is located below the jaws (for example Varian). Backscatter in these cases is determined from the size of the jaw opening. If small jaw-collimated fields are used in the treatments, the inclusion of output factor measurements for these field sizes may improve the accuracy. Furthermore, Eclipse will issue a warning if field size is less than the measured beam data. We recommend measuring down to 2x2 to avoid this warning. Measurement of output factors for field sizes smaller than 3x3 cm^2 requires careful choice of detector. For field size ≥ 2x2 cm^2, small volume ionization chambers can be used without correction; however, for smaller field sizes and for detector types other than small volume air ionization chambers correction factors are necessary. See ICRU Report 91 Prescribing, Recording, and Reporting of Stereotactic Treatments with Small Photon Beams for additional information.
- The Jaw Tracking algorithm will allow field sizes as small as the minimum field size configured in the Operating Limits defined for the machine in RT Administration. The Minimum Field X and Minimum Field Y should be configured in RT Administration to the smallest desired jaw size. The dose calculation algorithm will extrapolate the output factor if the jaw size is smaller than the smallest configured field size. The most conservative approach is to set Minimum Field X and Minimum Field Y to match the smallest measured output factor. If the minimum field sizes are set less than the smallest measured output

factor, the accuracy of calculation should be verified either by measurement or comparison with published data (see, for example, Wen N, Li H, Song K, et al. Characteristics of a novel treatment system for linear accelerator-based stereotactic radiosurgery. J Appl Clin Med Phys 2015;16:5313)

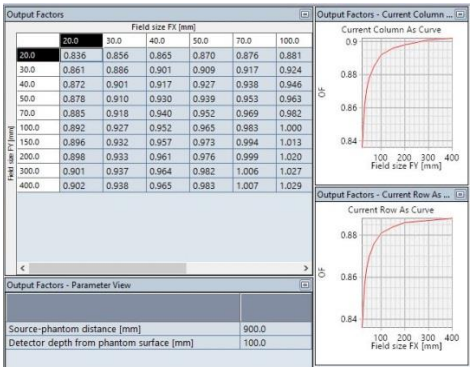
- See ICRU Report 91 Prescribing, Recording, and Reporting of Stereotactic Treatments with Small Photon Beams and IAEA Technical Report 483 Dosimetry of Small Static Fields Used in External Beam Radiotherapy for additional information.

Example of 10X-FFF energy on the TrueBeam STx machine at UAB:

1) Depth Dose curves, Profiles and Diagonal profiles were measured using a3D water tank (60 cm x 50 cm x 40.8 cm scan range) and a 0.125 cm^3 ionization chamber (PTW 0.125 cm^3 Semiflex Chamber Type 31010).



2) Output factors were measured for X x Y field sizes 3, 4, 5, 7, 10, 15, 20, 30, and 40 cm using a 0.125 cm^3 ionization chamber at 10 cm depth and 90 cm SSD. For field sizes 2 cm x Y and X x 2 cm, output factors were measured relative to the 4 cm x 4 cm field using a 0.007 cm^3 ionization chamber (Exradin A16), a synthetic diamond detector (PTW microDiamond Type 60019), and a diode designed for stereotactic field measurements (Exradin D1V) . All detectors yielded an output factor within 0.5% of the average. The algorithm reference guide recommends that output factors be measured at 5 cm depth, 95 cm SSD but notes that any geometry having source-to-detector distance 100 cm and depth at least 5 cm is acceptable. At UAB, we chose 10 cm depth to match the TG-51 calibration condition.



Field size FY [mm] \ Field size FX [mm]	20.0	30.0	40.0	50.0	70.0	100.0
20.0	0.836	0.856	0.865	0.870	0.876	0.881
30.0	0.861	0.886	0.901	0.909	0.917	0.924
40.0	0.872	0.901	0.917	0.927	0.938	0.946
50.0	0.878	0.910	0.930	0.939	0.953	0.963
70.0	0.885	0.918	0.940	0.952	0.969	0.982
100.0	0.892	0.927	0.952	0.965	0.983	1.000
150.0	0.896	0.932	0.957	0.973	0.994	1.013
200.0	0.898	0.933	0.961	0.976	0.999	1.020
300.0	0.901	0.937	0.964	0.982	1.006	1.027
400.0	0.902	0.938	0.965	0.983	1.007	1.029

It is recommended that commissioning data be compared with published beam data.[3,4]

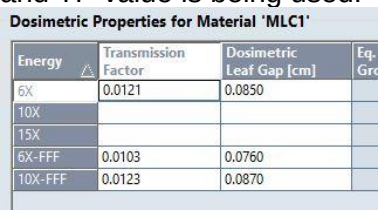
2) Definition of the MLC parameters 'Transmission Factor' and 'Dosimetric Leaf Gap':

Measurement of the MLC parameters 'Transmission Factor' and 'Dosimetric Leaf Gap' (DLG) is done using instructions that can be found in the Eclipse Photon and Electron Algorithms Reference Guide, Chapter 3, page 258 and use the DLG and transmission measurement technique described on myvarian.com. When performing the DLG-measurements, make sure that a narrow sliding gap (<5mm) is present.

To obtain acceptable agreement between calculation and measurement for clinical VMAT SRS plans, the DLG configured in the planning system is typically different from the measured value. See, for example, Wen N, Li H, Song K, *et al*. Characteristics of a novel treatment system for linear accelerator-based stereotactic radiosurgery. J Appl Clin Med Phys 2015;16:5313. When defining the MLC parameters, use the measured DLG and transmission factor as a starting point. Then adjust the DLG based on clinically relevant cases. For sites not having clinical VMAT SRS data sufficient for configuring the MLC parameters, phantom plans using the same phantom as end-to-end testing (see below) can be used.

If needed, the MLC transmission factor and the dosimetric leaf gap may be configured for individual AAA and AcurosXB calculation beam models. Furthermore, individual models support multiple sets of MLC parameters for different purposes, such as SRS VMAT treatments versus IMRT treatments. A set of MLC parameters is attached to a calculation beam model by creating a new Add-On of the type MLC in Beam Configuration. When activating the MLC Add-On, no re-configuration is required or any additional calculation of the beam data is needed. If an MLC Add-On is present in the beam data, the AAA and AcurosXB algorithms will use the MLC dosimetric parameters set in the beam data instead of the parameters defined in RT Administration. If no MLC Add-On is present in the beam data, the MLC dosimetric parameters set for the Add-On in RT Administration will be used. If multiple MLCs are configured per energy or technique then the user must select the correct MLC prior to final dose calculation.

Example of the MLC dosimetric parameters of the TrueBeam® STx machine at UAB. As the machine is dedicated for SRS and SBRT treatments mainly using VMAT, only one set of DLG- and TF-value is being used.



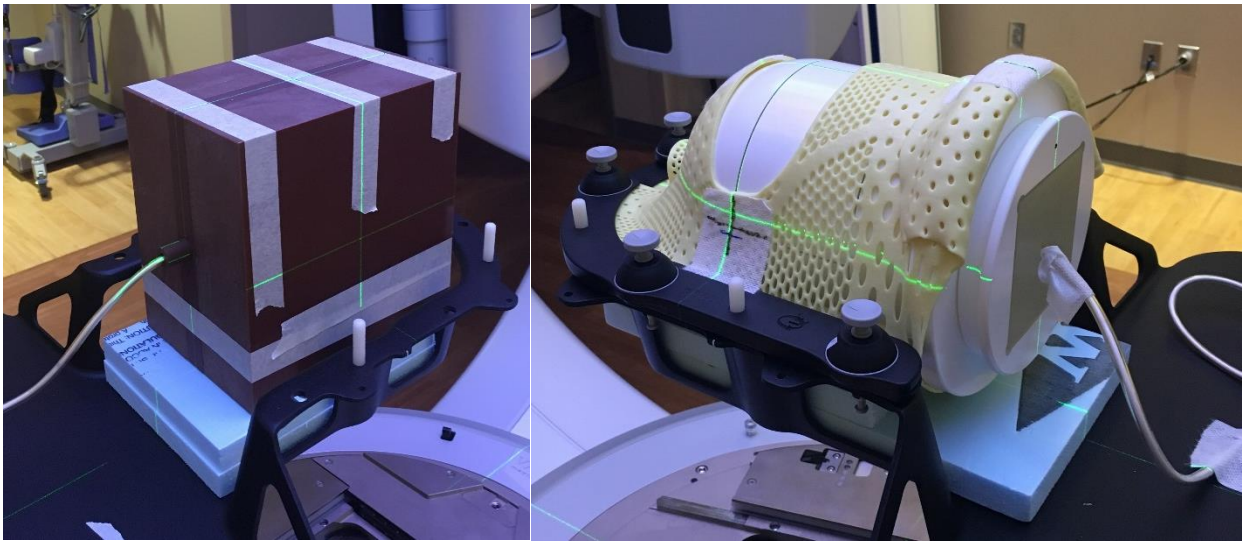
3) Change in V15.5 related to Tongue-and-Groove modeling

The Tongue and Groove implementation has been improved in Eclipse 15.5. The improvement is most noticeable for the High Definition MLC. In 15.5, for each fluence pixel that is partially covered by the leaf, the fluence value is calculated based on the exact fraction of the pixel

covered. In previous versions, the calculation of the fraction covered was grid size dependent. The improvement should result in close agreement between the measured DLG and the value that optimizes agreement with measured treatment plans. However, until more data is available on the degree of improvement users should continue to follow current clinical practice of adjusting the configured DLG to match a set of relevant clinical plans.

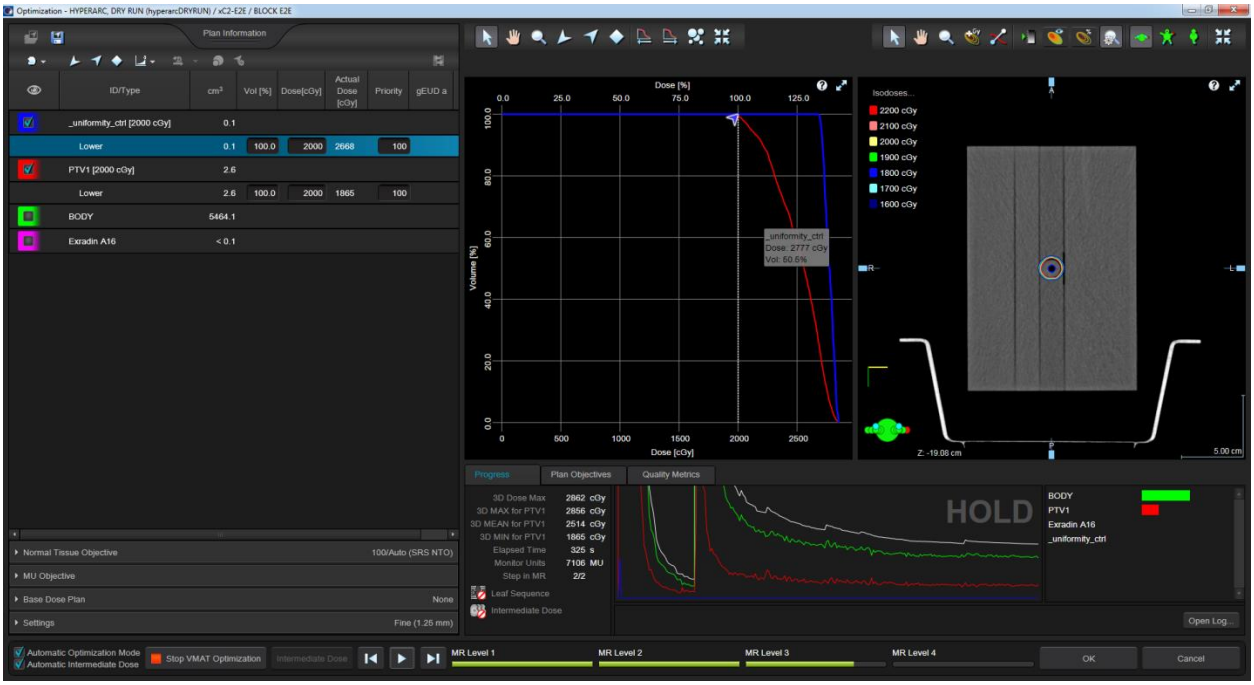
Dosimetrical validation of the configuration:

End-to-end testing is valuable for demonstrating readiness of the planning and delivery system for clinical use. End-to-end testing should be composed of a high-accuracy point measurement coupled with a high-resolution relative measurement. Typically, radiochromic film coupled with a micro-ionization chamber are the detectors of choice for end-to-end testing. The phantom can range from a simple stack of water-equivalent plastic to an anthropomorphic skull phantom. The phantom should be placed in the Encompass™ device with a mask, analogous to a patient. A mask is not necessary for a block phantom or other phantoms with a simple geometry. If a mask is not used, care must be taken to ensure that the phantom can be placed reproducibly with respect to the Encompass base. The fiducial marks on the base and marks on the phantom can be used for this purpose. Two example phantom setups are shown below.

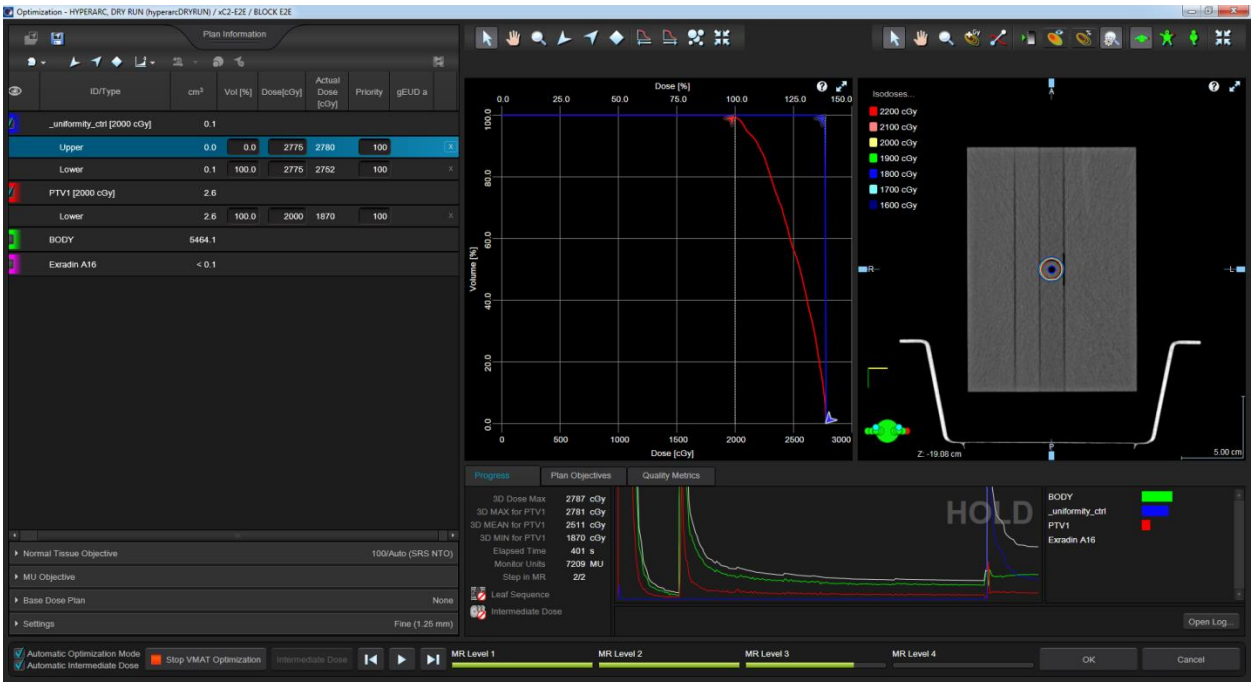


After a CT is obtained and imported into Eclipse, a target is drawn. The simplest target is a sphere centered on the point dose detector position. Note that this document does not cover the intricacies of target registration. For details on image and target registration QA please refer to TG-132.When using a micro-ionization chamber, the field size dependence must be taken into consideration. To facilitate accurate absolute dosimetry using a micro-ionization chamber, the target used for end-to-end testing should be approximately 1.5 cm diameter. Additionally, a small structure (approximately 5 to 7 mm diameter) concentric with the target volume should be created. This region-of-interest will be used to ensure a uniform dose within the volume of the chamber. A plan should be created using the standard HyperArc planning wizard. Midway through optimization, optimization should be paused, the median dose to the small volume noted, and an

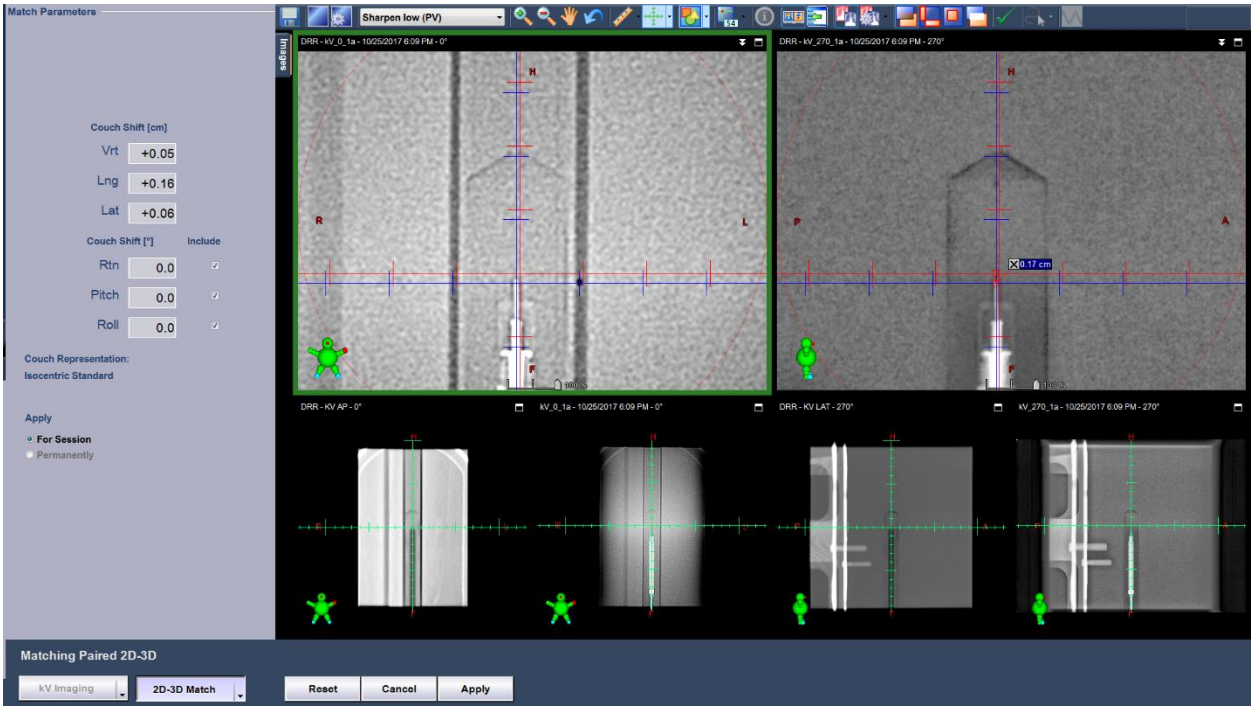
upper and lower objective at the median dose created for this structure. Note that this structure is specifically for creating a uniform dose to facilitate measurement and is not a component of clinical planning for patients.



After the optimization has proceeded for sufficient iterations for the cost function to converge, the optimization should be allowed to continue.

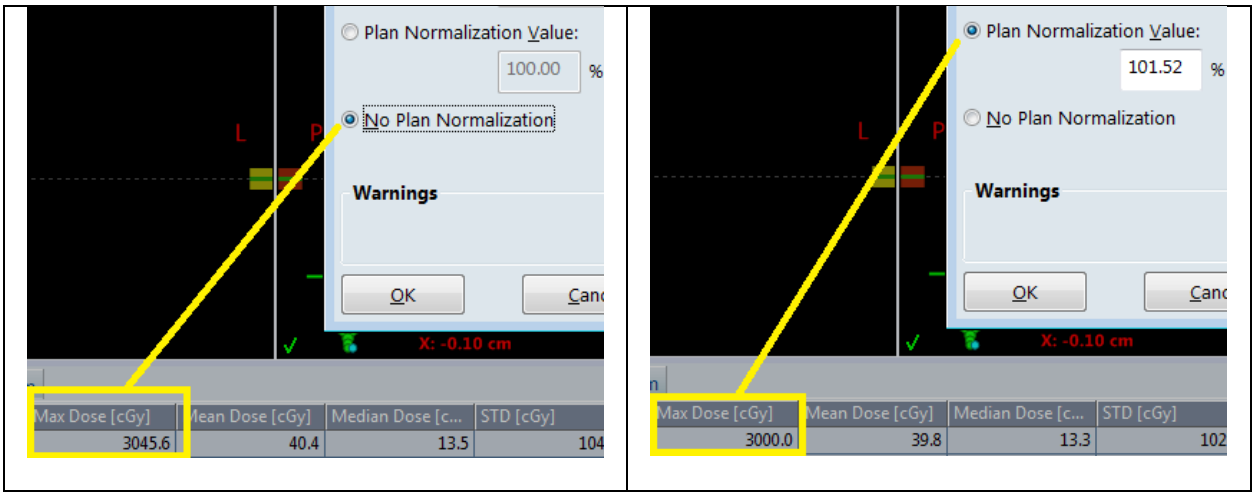


After the plan is completed, the dose distribution in the region of the point detector should be inspected to ensure that it is uniform. The plan delivery should follow the standard treatment protocol, including image guided setup. Use of image guidance to align the phantom and detectors in 6 degrees of freedom will help ensure accurate measurements.



An external audit can be used to substitute for or supplement internal end-to-end testing. The MD Anderson Dosimetry Laboratory (http://rpc.mdanderson.org/mdadl/home.htm) can provide a stereotactic radiosurgery head phantom containing radiochromic film and TLD. After irradiation, the institution returns the phantom to the MDADL, where the TLD and film data are compared with the treatment plan. The MDADL provides the institution with a detailed report of the results. The CT of the phantom should be obtained in the Encompass device. Note that the treatment planning instructions were not developed for HyperArc and specify “cover the target with 25 Gy (prescription isodose line >85%).” The important goal is that the dose to the center of the target be approximately 30 Gy. For centers that do not use a homogeneity constraint, the maximum dose is approximately 150% and the prescription should be 20 Gy. After planning, the maximum dose should be in the range 29 to 31 Gy. The plan normalization should then be adjusted to set the maximum dose to 30 Gy. To set the maximum dose to 30 Gy, set the plan normalization = 100% * MaxDose [Gy] / 30 Gy.

No plan normalization. Maximum dose 30.456 Gy.	Plan normalization 101.52% (100% x 30.456 / 30). Maximum dose 30 Gy.



For centers that use a homogeneity constraint, the prescription dose and optimization parameters should be set such that the plan characteristics are similar to a clinical plan but with maximum dose 30 Gy. Before delivery of the plan to the MDADL phantom, the standard patient-specific QA procedures should be followed. The plan should be delivered to the MDADL phantom using the standard treatment protocol, including image guided setup. Review of the MDADL report should include comparison of the phantom results with the patient-specific QA measurements.

Mechanical and Radiation Tests

The accuracy of the delivery from a mechanical and radiation stand point should be evaluated prior to the implementation of the new SRS protocol.

For the mechanical checks, following the AAPM TG 142 and the ASTRO white paper can be used as a reference.

It is recommended to follow the procedures available in the TrueBeam 2.7 Instructions for Use available at myvarian.com P1011692-003-C.

Machine Performance Check specific for HyperArc:

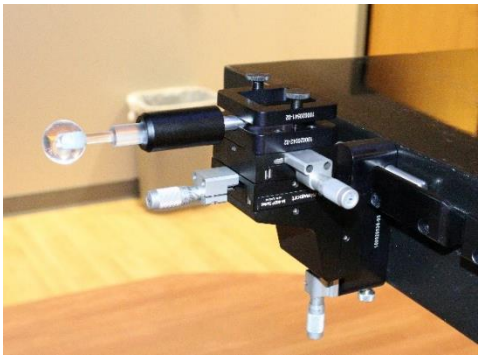
The purpose of the Machine Performance Check (MPC) is to verify that various machine parameters, radiation, mechanical and imaging, are within product specifications. Daily measurement using MPC is advised prior to clinical operation of the machine. However, it is not a substitute of QA activities performed by medical physicists. The use of MPC method on the TrueBeam machine has been reported in the literature (JACMP V18, p139-; Radiat Onc V10, p97-).

Additional information on MPC may be found at myvarian.com TrueBeam V2.7 Machine Performance Check Reference Guide and newer.

Of note repeated to HyperArc MPC 2.7 now includes the “Extended Couch Check” which will measure the Gantry Couch and Collimator isocenter over the full range of couch travel (+/-90 degrees)

The Machine Performance Check (MPC) includes geometric tests and may be used to supplement machine QA for SRS; however, the MPC cannot replace independent QA testing. At the time of this document, there is no guidance from professional societies about integrated QA systems such as MPC. Furthermore, the geometric QA tests used the 6 MV flattened beam and the correspondence between the radiation isocenter of the 6MV flattened beam and the 6MV and 10 MV flattening filter free beams has not been established. Finally, the utilization of manufacturer-supplied integrated QA tools is not well established. Until formal guidance is available from professional organizations such as the AAPM, users should not modify or reduce existing QA programs based on MPC. If MPC is used to supplement QA it should be subjected to rigorous commissioning and ongoing QA as well. Evaluations of MPC are available in the literature [5-8].

Winston-Lutz Test



In TG-142 there is a recommendation to verify the mechanical isocenter. This is especially important in SRS/SBRT due to the higher degree of targeting accuracy required and the smaller size of the target. The purpose of the Winston-Lutz test is not only to verify the mechanical isocenters but to verify laser alignment as well. It is recommended for both cone-based SRS as well as MLC-based SRS. The basis of the test is to verify there has been no shift of the isocenter or the MLC relative to the isocenter. There are various Winston-Lutz (WL) procedures available.

Verification of coincidence of mechanical, radiation, and imaging isocenters is a key component of SRS quality assurance. The traditional Winston-Lutz test is used to evaluate the deviation of the target position from the center of a circular cone aperture as a function of gantry angle. For HyperArc, the MLC replaces the cone and the deviation of the target position from the center of the MLC, as defined by a small square aperture is measured. Additionally, the couch walkout and collimator walkout are measured by evaluating the target position as a function of table angle and the aperture center as a function of collimator angle, respectively. There are various procedures available for testing the coincidence of mechanical, radiation, and imaging isocenters. At UAB a target object is composed of a UAB manufactured 6 mm diameter tungsten sphere embedded concentric within a 25 mm diameter acrylic sphere mounted to the 3-axis micrometer mount provided by Varian.

1. Obtain a cone-beam CT at 1 mm slice thickness.
2. Do a 3D image registration based on the outer acrylic ball. The image registration uses a phantom CT with a 25 mm diameter sphere structure at isocenter created in Eclipse.
3. Apply the shifts extracted from the DICOM registration file to the micrometer, thus placing the target at radiation isocenter. Alternatively, the couch offsets can be applied after CT registration; however, this introduces couch translation error into the process. The couch translation error is < 0.5 mm.
4. Repeat steps 1-2 to verify that target is at the imaging isocenter.
5. Obtain EPID images using a 3 cm square MLC field at 45 degree increments of gantry angle.
6. Analyze the target-aperture offsets.
7. Obtain EPID images at gantry zero using a 3 cm square field at 30 degree increments of collimator angle.
8. Analyze the location of the aperture center to determine the smallest circle containing all centers to evaluate collimator walkout.
9. Obtain EPID images at gantry zero using a 3 cm square field at 22.5 degree increments of table angle.
10. Analyze the location of the target to determine the smallest circle containing all centers to evaluate table walkout.

Patient positioning and delivery automation

As part of the ability for the treatment to be delivered via automation, the patient fixation device that is required for the HyperArc treatment is the Encompass fixation device from QFix. Within the Encompass fixation device, a patient protection zone has been defined in which we allow specific arc geometries based on the placement of the isocenter. This patient protection zone has been implemented on the treatment unit and the machine flags the plan that 'automated delivery' is not allowed in case the couch position is not within the defined patient protection zone and automated delivery of the HyperArc plan will not be possible. The same patient protection zone (with additional margin of 5mm in all three directions) has been implemented in Eclipse treatment planning system so plans can be flagged in case the isocenter is positioned outside of the defined patient protection zone or arc geometry is violating the collision rules.

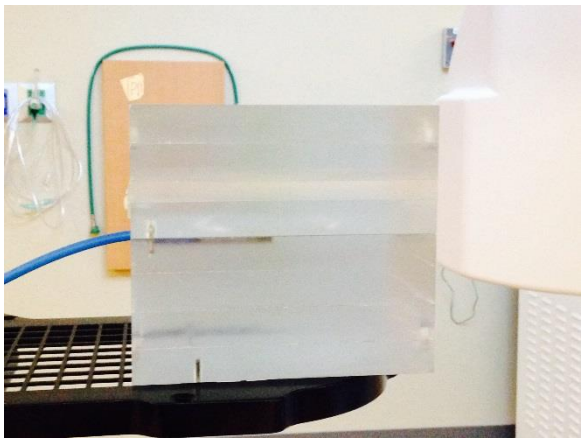
Eclipse treatment planning also models the 3D patient based on the body outline and the 3D treatment unit. A verification of possible collisions is done using the implemented Virtual Dry Run.

Once the delivery with automation is allowed, there is a designation that will alert the delivery system. However if automation of delivery is not desired, the designation can be removed within Eclipse.

When creating a verification plan of a HyperArc plan, the designation for automated delivery will be automatically removed for safety reasons.

QA Methods

Measurement based QA techniques are challenging for SRS of small targets. Point measurements are difficult because of changing detector response as a function of field size. Relative measurements using diode or chamber arrays are problematic because the detector spacing is similar to or larger than the target dimensions and, for ionization chamber arrays volume averaging is a significant issue. At UAB, we use radiochromic film with daily calibration to assess both the relative shape of the dose distribution and to estimate the absolute dose. We use EBT-XD (Ashland Inc., Covington, KY) having a range of 0.4 to 40 Gy. For each treatment plan, we measure a coronal plane through the centroid of the smallest and largest targets. The film is placed in an in-house built 18 cm x 18 cm x 17 cm phantom composed of 2 acrylic slabs. The phantom contains accurately placed pins for marking the film and fiducials for image guidance. The phantom is shown below:



The key points of the verification for a VMAT SRS plan at UAB are:

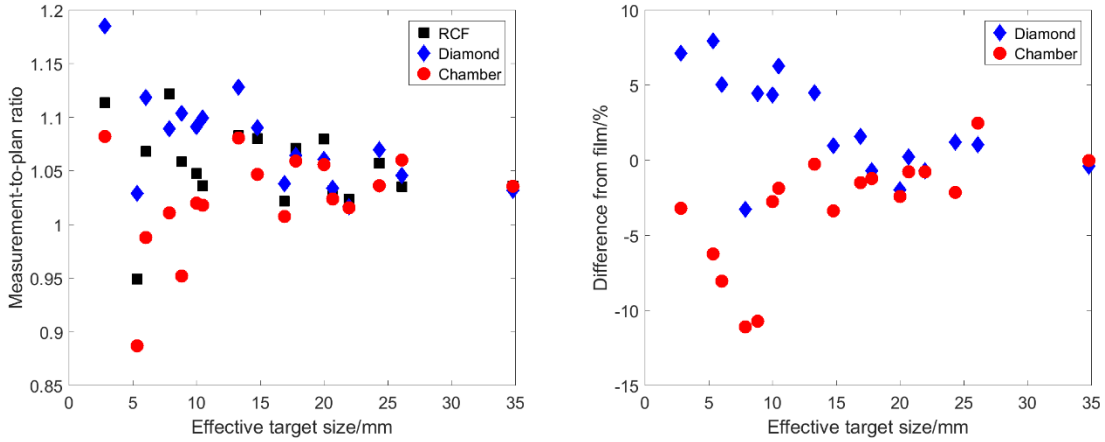
1. Locate the centroid of the target having the smallest volume using the move viewing planes tool. Calculate the offset between the centroid and the isocenter $(x_{QA},y_{QA},z_{QA}) = (x_{iso}-x_{centroid}, y_{iso}-y_{centroid}, z_{iso}-z_{centroid})$. This calculation can be readily automated using the Eclipse Scripting API.
2. Create a verification plan using the Eclipse Create Verification Plan wizard. Select a synthetic CT of the phantom having the origin located at the center of the film plane. Set the isocenter coordinates to (x_{QA},y_{QA},z_{QA}). Calculate dose.
3. Repeat 1 and 2 for the target having the largest volume.

4. Position the phantom on the treatment couch. Rapid positioning is facilitated by holes in the phantom that mate with the pins used for mounting headrest on the table insert. Obtain orthogonal kV images and adjust phantom position using fiducial markers.
5. Irradiate a 5 cm x 20 cm strip of film using an in-house developed single film calibration protocol.
6. Translate the couch to offset the isocenter to (x_{QA},y_{QA},z_{QA}).
7. Irradiate a 5 cm x 20 cm strip of film using the patient treatment plan. Mark the film using the fiducial pins.
8. Repeat 6 and 7 at the offset computed for the largest volume target.
9. After minimum 2-hour delay, scan the calibration and patient films using an Epson Perfection V700 flatbed scanner in transmission mode.
10. Import the calibration film image into in-house software to create a calibration curve.
11. Import a patient film image into in-house software. Identify the fiducial marks and apply the calibration to convert to a dose image.
12. Use image registration to compute the offset between the film dose image and the treatment plan.
13. Compute the ratio of the average film dose in the high dose region (>90% of the maximum dose) to the average calculated dose in the high dose region.
14. Apply the image shift computed in step 12 and the scaling factor computed in step 13 to the film dose. Compute the fraction of pixels exceeding gamma = 1 for 3%/1mm.
15. Assess the plan using the shift, scaling, and fraction of pixels exceeding gamma = 1.

The typical shift is 0.3 mm and the fraction of pixels having gamma > 1 is typically less than 1%. At UAB, clinical decision making has been driven primarily by the scaling factor, which is sensitive to the dosimetric leaf gap. If the DLG parameter in Eclipse is not carefully adjusted for SRS, measured dose can display clinically significant deviation from the calculated dose. Furthermore, it is important to periodically measure the dosimetric leaf gap as part of the machine QA program, because the measured DLG can drift or abruptly change. The resulting dose change is 0.5% to 1% per 0.1 mm change of dosimetric leaf gap. Users may also consider supplementing dosimetric leaf gap measurements with periodic measurements of one or more benchmark plans. Benchmark plans may be selected from the end-to-end tests used during commissioning and/or from the initial cohort of patient plans. Benchmark plans should not be considered a substitution for routine DLG checks.

The daily calibration is important for absolute dosimetry. There are multiple factors, including machine output, time between irradiation and processing, and variation in scanner performance, which can change the measured film response. Although the UAB QA process is based on tools developed in-house, similar QA protocols could be developed based on commercial tools. The manufacturer of EBT-XD sells an analysis package that includes the option for a single film daily calibration. Other vendors, such as Radiological Imaging Technology and Sun Nuclear, also offer radiochromic film analysis tools. There is a wide array of suitable commercial phantoms, including Sun Nuclear StereoPHAN™ and the Standard Imaging Stereotactic Dose Verification Phantom.

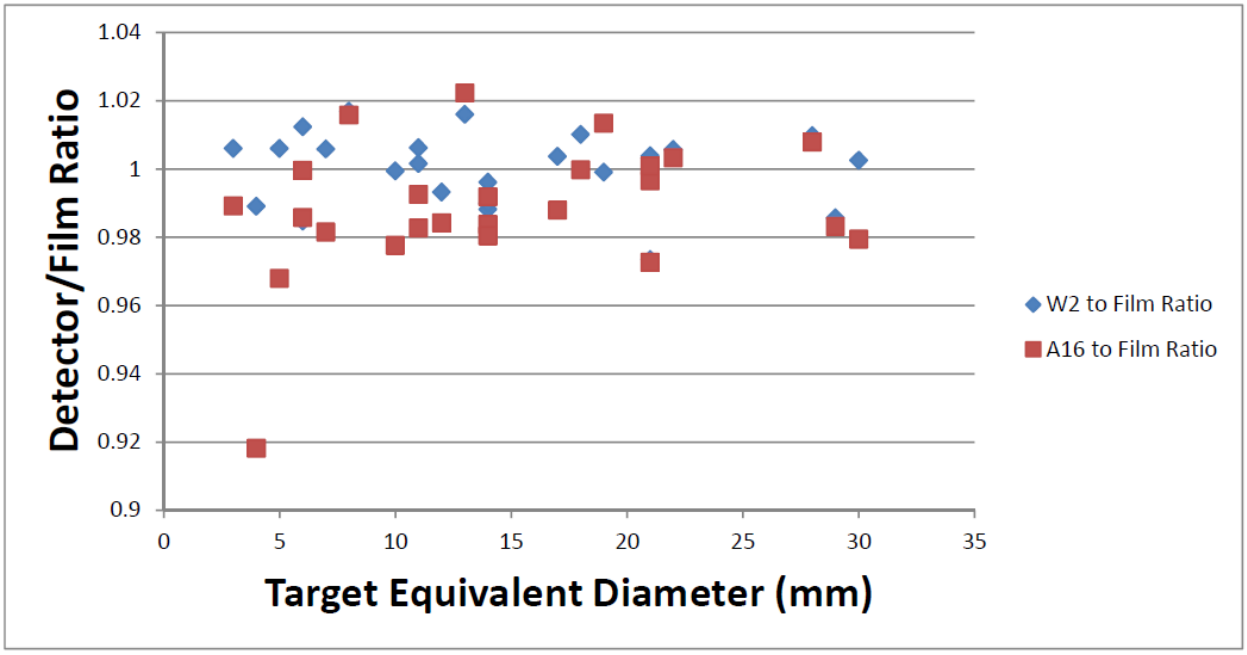
For targets having equivalent diameter >= 15 mm, a small volume ionization or synthetic diamond detector can be used to measure the dose. However, for smaller targets, the field size dependence of the detector response becomes significant. Shown below is a comparison of a 0.007 cm3 ionization chamber and a synthetic diamond with film.



It is important to note that, even for targets > 15 mm, the dose distributions for SRS are non-uniform and the measured dose will be sensitive to detector placement. To minimize this effect, the detector should be placed using image guidance.

Future of patient specific QA

The increasing utilization of SRS, particularly using techniques that require patient-specific quality assurance, has motivated vendors of detectors to invest in the development of tools suitable for small target dosimetry. One promising detector is a scintillator detector. Preliminary results from research at UAB, shown below, suggest that it does not have any measurable dependence on field size.



Secondary dose calculation tools are often based on approximations that break down in small field sizes. However, secondary dose calculation systems that do a full 3-dimensional dose calculation using modern, treatment planning grade, dose calculation algorithms are now available. These systems were developed for conventional radiation therapy and are not yet reliable for SRS. However, if these companies devote engineering resources to improving accuracy for small targets, it is likely that they will replace film. The secondary dose calculation will be used to check that the planning system is accurate, and a point dose measurement will ensure that the delivery system is operating correctly.

Acknowledgements

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Summary

This document serves as a guideline for those who would like to start a brain SRS program. The final implementation of the SRS program is the responsibility of the onsite users.

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Appendix A: Phantom positioning script

```
using System;
using System.Linq;
using System.Text;
using System.IO;
using System.Collections.Generic;
using System.Reflection;
using System.Runtime.CompilerServices;
using VMS.TPS.Common.Model.API;
using VMS.TPS.Common.Model.Types;

[assembly: AssemblyVersion("1.0.0.1")]

namespace VMS.TPS
{
  public class Script
  {
    public Script()
    {
    }

    [MethodImpl(MethodImplOptions.NoInlining)]
    public void Execute(ScriptContext context /*, System.Windows.Window window, ScriptEnvironment
environment*/)
    {
          StringBuilder result = new StringBuilder();
          IEnumerable<Structure> rtsset = context.StructureSet.Structures;

          result.AppendFormat("<html>\n");

          result.AppendFormat("<p>Calculation is for the second generation acrylic UAB IMRT phantom.</p>\n");

          var targets = from s in rtsset
                  where (s.DicomType.Equals("GTV") || s.DicomType.Equals("CTV"))
                  orderby s.Volume descending
                  select s;

          VVector iso = context.PlanSetup.Beams.First().IsocenterPosition;

          VVector phanIso = iso - targets.First().CenterPoint;
          result.AppendFormat("<h1>{0}</h1>\n", targets.First().Id);
          result.AppendFormat("<p>Volume = {0:0.00} cc</p>\n", targets.First().Volume);
          result.AppendFormat("<p>Phantom isocenter = {0:0.00}, {1:0.00}, {2:0.00}<p>\n",
Math.Round(phanIso.x,1) / 10, Math.Round(phanIso.y,1) / 10, Math.Round(phanIso.z,1) / 10);

          if (targets.Count() > 1)
          {
             phanIso = iso - targets.Last().CenterPoint;
             result.AppendFormat("<h1>{0}</h1>\n", targets.Last().Id);
             result.AppendFormat("<p>Volume = {0:0.00} cc</p>\n", targets.Last().Volume);
             result.AppendFormat("<p>Phantom isocenter = {0:0.00}, {1:0.00}, {2:0.00}<p>\n",
Math.Round(phanIso.x,1) / 10, Math.Round(phanIso.y,1) / 10, Math.Round(phanIso.z,1) / 10);
          }

          result.AppendFormat("<h1>All targets</h1>\n");
          result.AppendFormat("<ul>\n");
```

```
            foreach (var s in targets)
            {
                phanIso = iso - s.CenterPoint;
                result.AppendFormat("<li>{0} - {1:0.00} cc, isocenter position = {2:0.00}, {3:0.00}, {4:0.00}</li>\n",
s.Id, s.Volume, Math.Round(phanIso.x,1) / 10, Math.Round(phanIso.y,1) / 10, Math.Round(phanIso.z,1) / 10);
            }
            result.AppendFormat("</ul>\n");

            // Display result
            var html = result.ToString();
            string fname = Path.Combine(Path.GetTempPath(), "srsphantomposition.html");
            File.WriteAllText(fname, html);
            System.Diagnostics.Process.Start(fname);
        }
    }
}
```