Elekta

Customer Perspective

Transform Leksell Gamma Knife® workflows with game-changing planning tools

Leksell GammaPlan® Remote helps the London Gamma Knife Centre increase flexible working.

Leksell Gamma Knife® Lightning helps enhance decision making, improve planning consistency and save valuable time.

Contributor

Benjamin Earner
Principal Physicist
HCA Healthcare UK

The London Gamma Knife Centre
at The Wellington Hospital

part of HCAHealthcare UK

About

The London Gamma Knife Centre

Location

The Platinum Medical Centre
St John's Wood, London, UK

Website

www.hcahealthcare.co.uk/facilities/the-wellington-hospital/our-centres/the-london-gamma-knife-centre

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Background

The purpose-built London Gamma Knife Centre is located at the Platinum Medical Centre in St John's Wood, London. A part of HCA Healthcare UK's The Wellington Hospital, the center provides patients access to a multidisciplinary team (MDT) of experts—including neurosurgeons, oncologists, radiologists, physicists and radiographers. Joint MDTs between The Wellington Hospital and its sister hospital, The Harley Street Clinic, amplifies the MDT benefit.

Equipped with Leksell Gamma Knife® Icon™ and the latest Leksell GammaPlan® treatment planning software, the center also has Leksell GammaPlan® Remote (LGP Remote) and Leksell Gamma Knife® Lightning (LGK Lightning) treatment planning optimizer, which were installed in December 2020.

LGP Remote experience

Leksell Gamma Plan Remote provides flexible and secure access to Leksell GammaPlan from remote locations—anytime, anywhere.

Easier collaboration between multidisciplinary teams

The team at the London Gamma Knife Centre had been looking for an application to facilitate remote working with GammaPlan for some time when they obtained Remote. They particularly wanted to have all relevant patient data at hand during weekly MDT meetings.

"Increasingly, especially with metastatic disease, we are seeing patients who have been treated using Gamma Knife before and it is useful for the MDT to see exactly what locations/areas have been treated previously and what sites are new," explains Benjamin Earner, Principal Physicist for HCA Healthcare UK. "In the past, to discuss this during the MDT meeting, we would have to export the relevant data from GammaPlan, import into another TPS, fuse the images and co-register everything, which was inefficient and time-consuming. Also, if there were any last-minute additions to the weekly MDT patient list, we wouldn't have all this information at the time of the MDT, which would delay the decision-making process for that patient."

> With LGP Remote, we can now access the data in GammaPlan quickly and easily during the MDT

"We can see where we've treated previously, and we can import and co-register any new images easily. Remote allows the MDT to make informed decisions with a lot more confidence and without delay, which is crucial with such cases. It also reduces my workload—it is much more efficient."

Reducing travel time in a multi-site environment

The Wellington Hospital is multi-site, with physicists based at The Harley Street Clinic and GammaPlan workstations at the Platinum Medical Centre—so meetings and training for staff used to involve a lot of traveling between sites. Benjamin Earner has found Remote extremely helpful in this regard.

"Since I can now access GammaPlan offsite, training members of staff is a lot easier than before," he explains. "No one needs to lose time traveling. I can fire up GammaPlan wherever I happen to be working, and can demonstrate the planning process, look at previous cases, or help solve issues, simply by sharing my screen."

LGP Remote has also enhanced the planning process for arteriovenous malformation (AVM) patients.

"Sometimes, we want to check the angiograms to make sure they import correctly and are the correct ones for the treatment. The angiography suite at The Wellington Hospital is in a separate building, 10–15 minutes away from the Gamma Knife Centre, which previously posed some difficulties in checking the images within GammaPlan. Before we had Remote, this was a nightmare because we had to travel to the North building, get the images, rush back to the GammaPlan workstation and check that everything imported OK. By this time the patient would be off the bed, and so acquiring new images would be a huge inconvenience for everyone," says Earner. "With Remote, I can open up GammaPlan in the angiography suite, and I can check that all the images import correctly there and then. The doctor can see them and, if they need to do anything more, they can do so without delay. It's a really quick process now, which is better for everyone."

Easier data sharing and viewing

"If a patient goes on to have treatment elsewhere, we often receive requests for previous treatment details, which is quite common in radiation therapy," he continues. "This used to be quite difficult because I would have to go to the GammaPlan workstation in person and download the relevant data.

> With Remote, data sharing is now very easy. I just log into GammaPlan wherever I am, export the data I need very simply and share it securely.

This was particularly helpful during the Covid pandemic. If I was working from home when someone requested previous treatment details, I could still send them the data promptly."

This easy access to data and images has also been beneficial to consultants when reviewing follow-up images and patient progress.

"LGP Remote has given us loads of options that we never really considered before," Earner comments. "On one occasion, our medical director wanted to assess how a treatment was progressing. We were both at home at the time but, with Remote, it was really simple. I could share my screen with him, bring in previous and follow-up images, and quickly see what was happening with that patient."

"In the future, we would like to explore its use for consultants who want to treat patients remotely," he adds. "At the moment, we're quite a hands-on department with consultants present during the treatment process, but it might be an option in the future for them to connect remotely. Our medical director would also like to use Remote during patient consultations, to refer to details or show them how the treatment is progressing. I can see Remote being used in that way increasingly."

Increasing flexibility

"I now use LGP Remote every day and it has definitely saved me a lot of time," he concludes. "The biggest thing is the flexibility it offers. I don't need to be tied down to a particular location—I've always got GammaPlan at my fingertips, which opens up a vast number of opportunities, whether that's engaging with consultants, reviewing patient treatments, or helping staff if they want another perspective on a plan review. It really helps all aspects of the workflow. I can't recommend it enough."

Leksell Gamma Knife Lightning experience

LGK Lightning is a fully integrated dose optimizer solution for intracranial radiosurgery that can reduce treatment planning times up to 80% and treatment delivery times up to 50%*.

*Data maintained internally by Elekta.

Prior to implementing Leksell Gamma Knife Lightning treatment optimizer, Benjamin Earner observed that the time required for Gamma Knife planning was very much dependent on the experience and skill of the planner. He was also aware of an increasing trend towards treating multiple brain metastases in one session.

"The challenge for multiple target treatments was that they took a long time to plan," he says. "Each target would be optimized individually. Then we would need to assess the whole plan and how the target isodoses influenced each other. It was quite an iterative process and the more targets you had, the longer it took to produce a good plan."

"When I was first introduced to Leksell Gamma Knife Lightning, I was really excited about its potential to solve both of these issues—planner dependency and the time required to plan for multiple targets," he adds.

Planning study

Before using Lightning clinically, in order to ensure that plan quality would not be compromised, the team set about comparing Lightning plans to manually generated clinical plans.

"We performed a planning study using previous clinical plans that our best, most experienced planners had prepared for all types of cases, and we replanned them using Lightning," Earner explains. "The great thing about Lightning is it's so quick. It didn't take long to perform this evaluation and we found that this solution was extremely competitive in terms of plan quality, meeting and sometimes exceeding the performance of manual planning. I was surprised at just how effective it was."

In their evaluation, the team compared metrics, such as coverage, Paddick conformity index (PCI) and gradient index (GI) for the targets. They also looked at mean dose and maximum dose for organs at risk (OAR), beam-on time (BOT), and shots required to see if there was significant difference between the two methods. In summary, the results of treatment planning parameters for Lightning were equal or improved compared to manual forward planning. Both the mean and max doses for OAR were on average lower in Lightning plans. Both of these aspects illustrate Lightning optimizer's ability to maintain plan quality while improving normal tissue sparing.

Earner comments, "Beam on time was not reduced as much as we expected, but I would stress that Lightning was going up against an expert planner, so we were already looking at the best we could achieve from GammaPlan manually, and Lightning is still able to do better."

"Moreover, Lightning is much faster," he continues. "Manual planning usually takes around 15 minutes on average, whereas Lightning produces high-quality plans within a minute, perhaps two if it's a really complex case."

Lightning produces high-quality plans within a minute.

In addition to the comparative study, a number of plans generated using Lightning were validated using Gafchromic EBT-XD film. Figure 1 shows the good agreement achieved for a pituitary adenoma plan.

"I found excellent agreement, both in Gamma pass rate and overlaid isodose lines," Earner adds. "Ultimately, I have great confidence that the plans Leksell Gamma Knife Lightning produces can be delivered to the patient accurately."

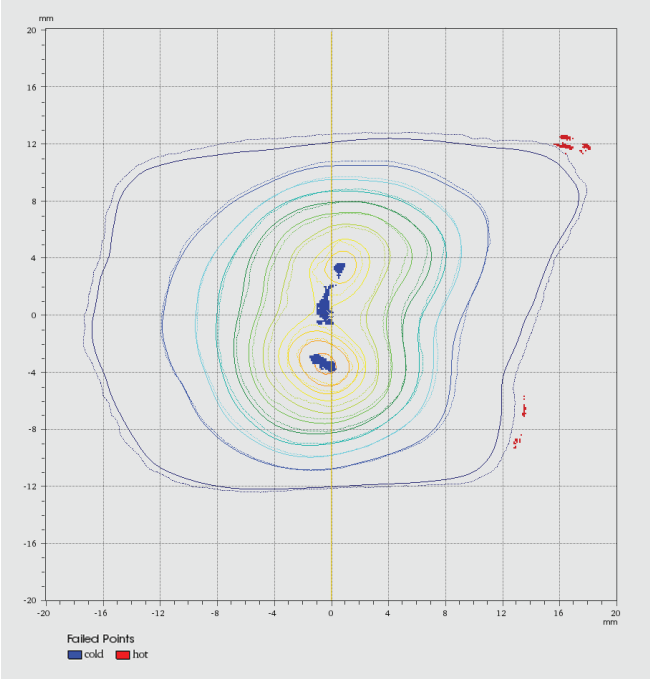


Figure 1.
Coronal dose distributions (isodose lines) for a pituitary adenoma plan generated with Lightning planning optimizer in GammaPlan (solid lines) and EBT-XD film (dashed lines). The Gamma Index is displayed for a 1% (local) / 1 mm / 10% reference maximum threshold. The passing rate is 99.4%. Failing points are shown in red (higher than planned) or blue (lower than planned).

Embracing Lightning

The team at the London Gamma Knife Centre are so impressed with Lightning performance that they've really embraced it and use it in most Gamma Knife cases now.

> "Lightning really addresses the issue of planner dependency," Earner says. "This is very much reduced because the performance, speed and consistency is there every time."

"If Lightning meets or exceeds our planning criteria and I'm happy with the plan, then I use the Lightning plan straight away, without comparing it to manual planning," he continues. "This allows us to fully benefit from the speed of the system. Obviously, where required, there is always the option to tweak the Lightning plan, but the optimizer will have done most of the hard work. The important thing is to run Lightning first because it's so fast and will provide a good answer 99% of the time."

"The speed of Lightning means that I can generate a few plans to find the best balance of parameters, such as beam on time and selectivity," he adds. "There is always a trade-off, but the way Lightning does this is the same as we would do it ourselves, which is pleasing to see."

Significant time savings

The Gamma Knife Lightning optimizer has saved a significant amount of planning time for the physicists at the center. This is particularly evident for the multiple brain metastases cases that they are seeing increasingly.

"While manual planning could easily take an hour or so for multiple target plans, Lightning can produce a good plan in around 60 seconds," Earner remarks. "This is where Lightning has been a game changer. It takes the stress out of planning. Not only does it save planning time for physicists, but it also means less waiting around for patients and consultants because the whole process is much faster."

"Previously, once the consultants finished contouring, they'd have to wait while the plan is produced, and the time it took was very much planner dependent," he continues. "Now they can be confident in the consistent performance of Lightning, and a much shorter wait to see the first plan. Often, the patient has barely had enough time to finish their tea before we're calling them in for their treatment."

The following case examples demonstrate the quality of plans that can be generated using Gamma Knife Lightning. These cases were treated using the Lightning plans and manual plans were prepared for comparison after treatment delivery.

Case example 1. Single brain metastasis

A thymic carcinoma patient received previous Gamma Knife treatments at the London Gamma Knife Centre for seven brain metastases over two sessions, in 2019 and 2020. The patient returned in 2021 with a single brain metastasis.

"This straightforward case demonstrates how quickly Lightning generates great results, producing a good plan in less than 60 seconds," says Earner. "After the treatment, I spent 15–20 minutes replanning this case manually and I couldn't beat Lightning in terms of plan quality."

The plans obtained using Lightning and manual planning are shown in figures 2 and 3. The Lightning plan achieved the same coverage as manual planning but with better conformity and shorter BOT (Table 1).

Case 1	Target						Delivery	
	Isodose (%)	Coverage	PCI	GI	Min dose (Gy)	Max dose (Gy)	BOT (mins)	Shots
Manual	43%	0.99	0.87	2.80	19.7	51.2	39	13
Lightning	46%	0.99	0.91	2.81	20.2	47.8	32	20

Table 1. Case example 1: Comparison of target dosimetric and delivery parameters for a single brain metastasis.

Figure 2. Case example 1: Lightning plan for a single brain metastasis.

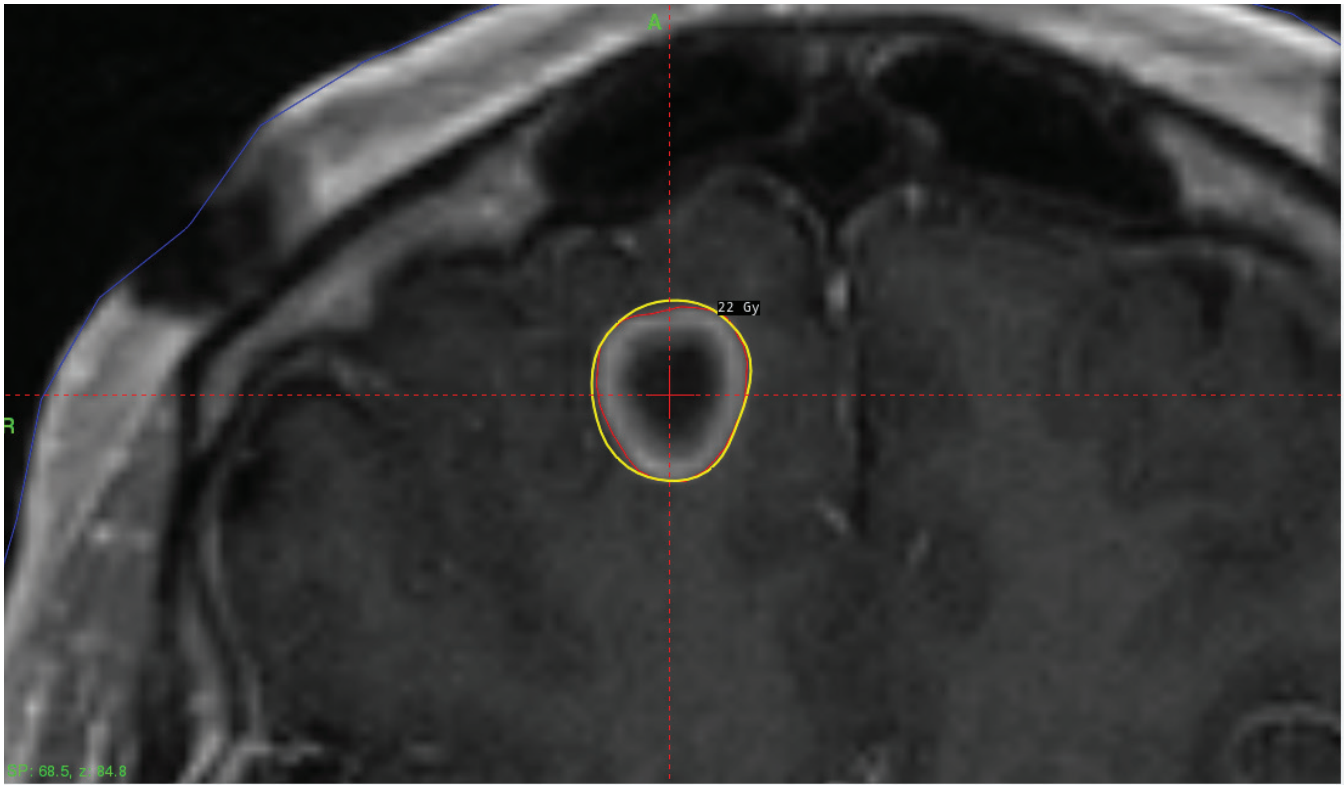


Figure 2a. Axial image.

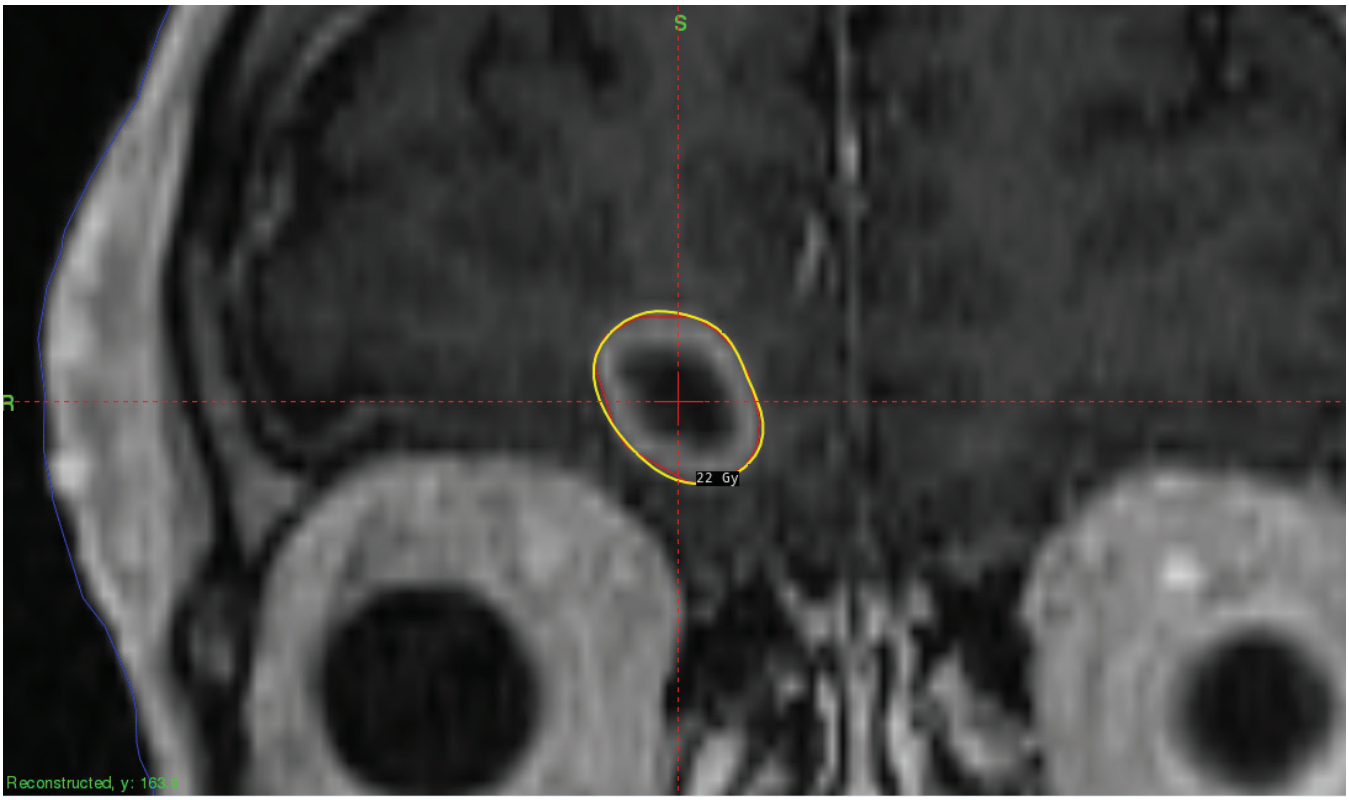


Figure 2b. Coronal image.

Figure 3. Case example 1: Manual plan for a single brain metastasis.

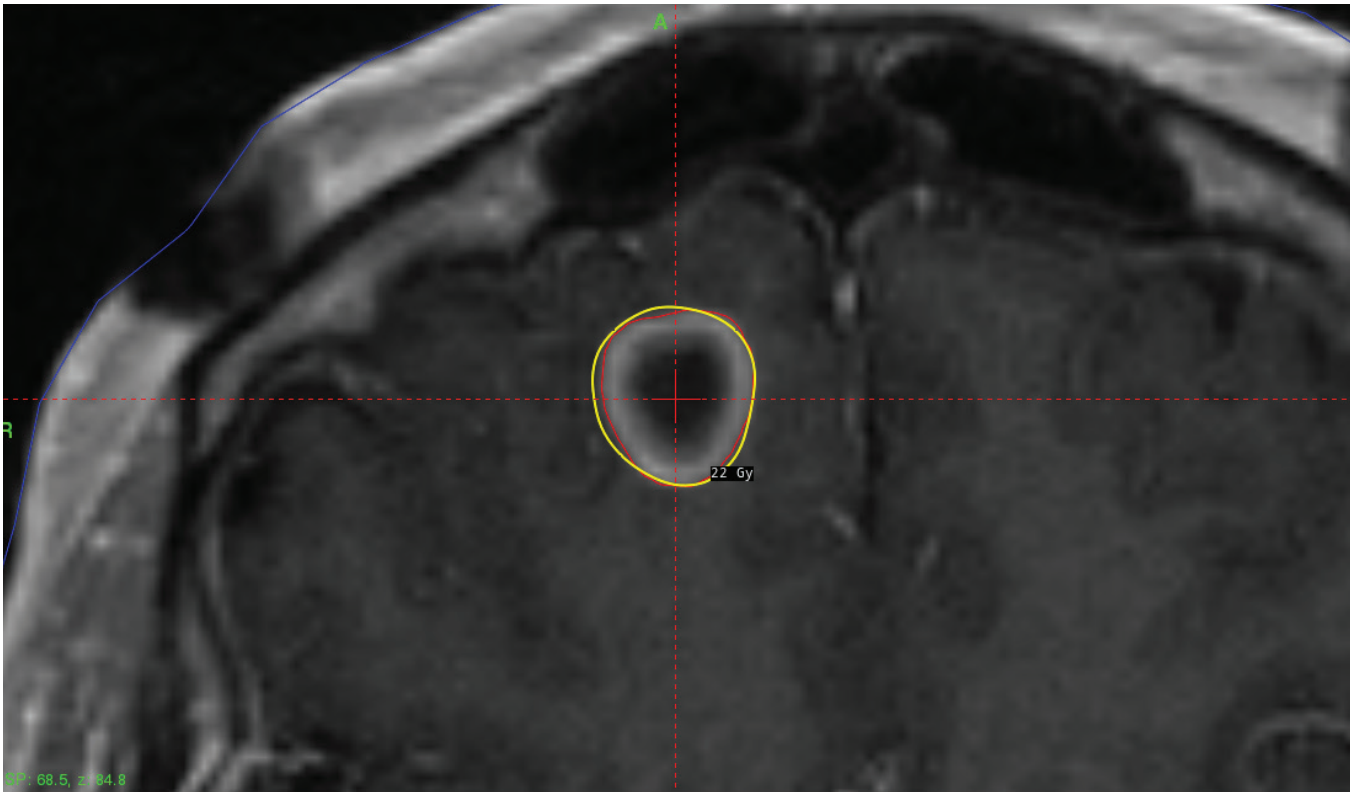


Figure 3a. Axial image.

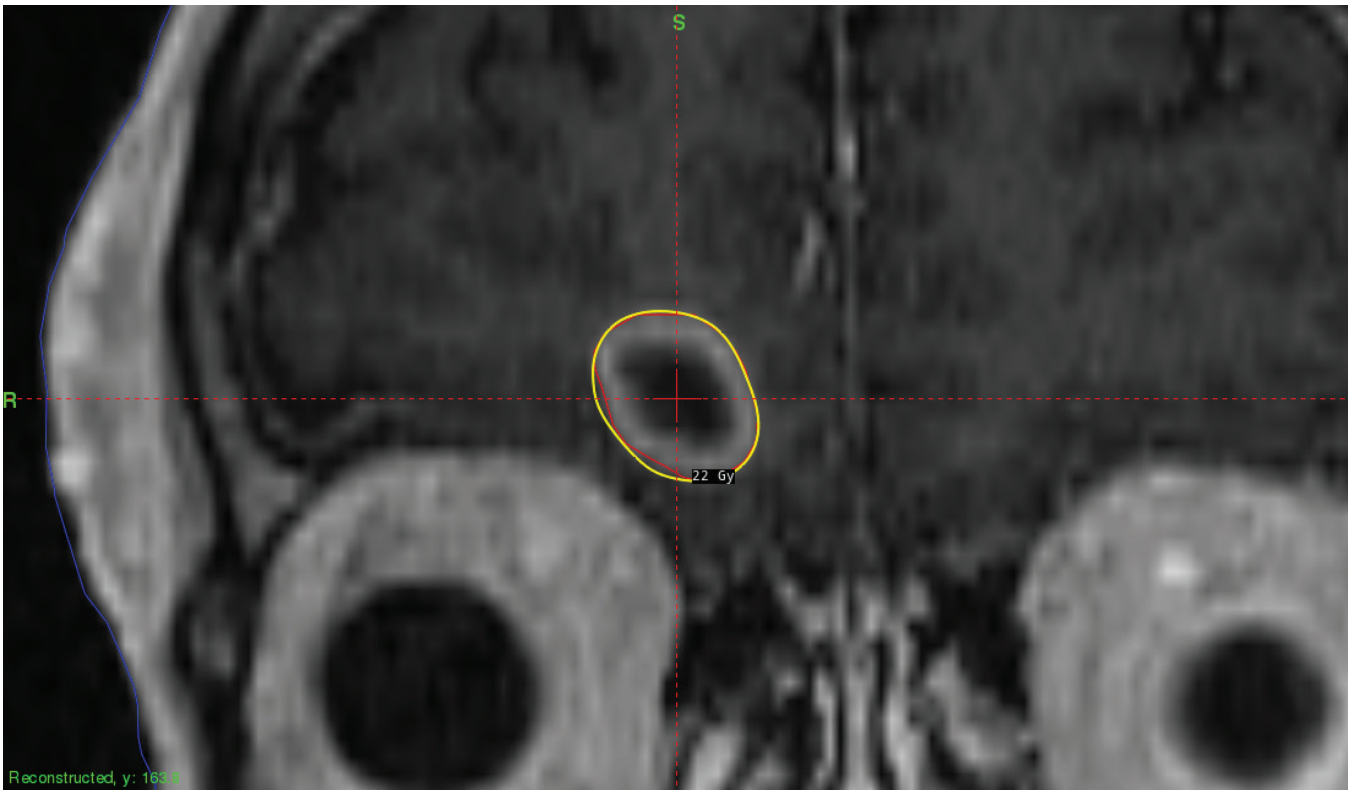


Figure 3b. Coronal image.

Case example 2. Vestibular schwannoma

This vestibular schwannoma case demonstrates how Lightning takes OAR constraints into account to produce a high-quality plan that meets planning criteria while ensuring cochlea dose is minimized and within constraints (max cochlea dose ≤ 4.0 Gy) (Table 2).

Case 2	Target						Delivery	
	Isodose (%)	Coverage	PCI	GI	Min dose (Gy)	Max dose (Gy)	BOT (mins)	Shots
Manual	53%	0.96	0.81	3.06	7.1	24.0	42	10
Lightning	41%	0.96	0.85	2.67	7.4	30.5	49	16

Table 2. Case example 2: Comparison of target dosimetric and delivery parameters for a vestibular schwannoma.

"Once OAR are contoured and the maximum OAR dose is entered, Lightning adapts to these constraints from the start," Earner explains. "Normally, with manual planning, this is something I might tweak towards the end of planning."

> "I find Lightning is much better at dealing with OAR constraints, it ensures consistency between planners and, of course, is much faster."

"In this case you can see that the 4 Gy isodose line nicely contours around the cochlea in the Lightning plan (Figure 4)," he continues. "I couldn't achieve this plan quality with manual planning (Figure 5). I could improve the 4 Gy isodose line, but at the cost of PCI and GI. The plan meets our local goal of PCI ≥0.85 and GI ≤ 3.0, and max cochlea dose ≤ 4.0 Gy. So, in that sense an extra 7 minutes is well worth it. Lightning produced a plan that meets all our targets in terms of PCI (≥ 0.85) and GI (≤ 3.0), while ensuring BOT is still acceptable, and it was able to do this very easily."

Figure 4. Case example 2: Lightning plan for a vestibular schwannoma.

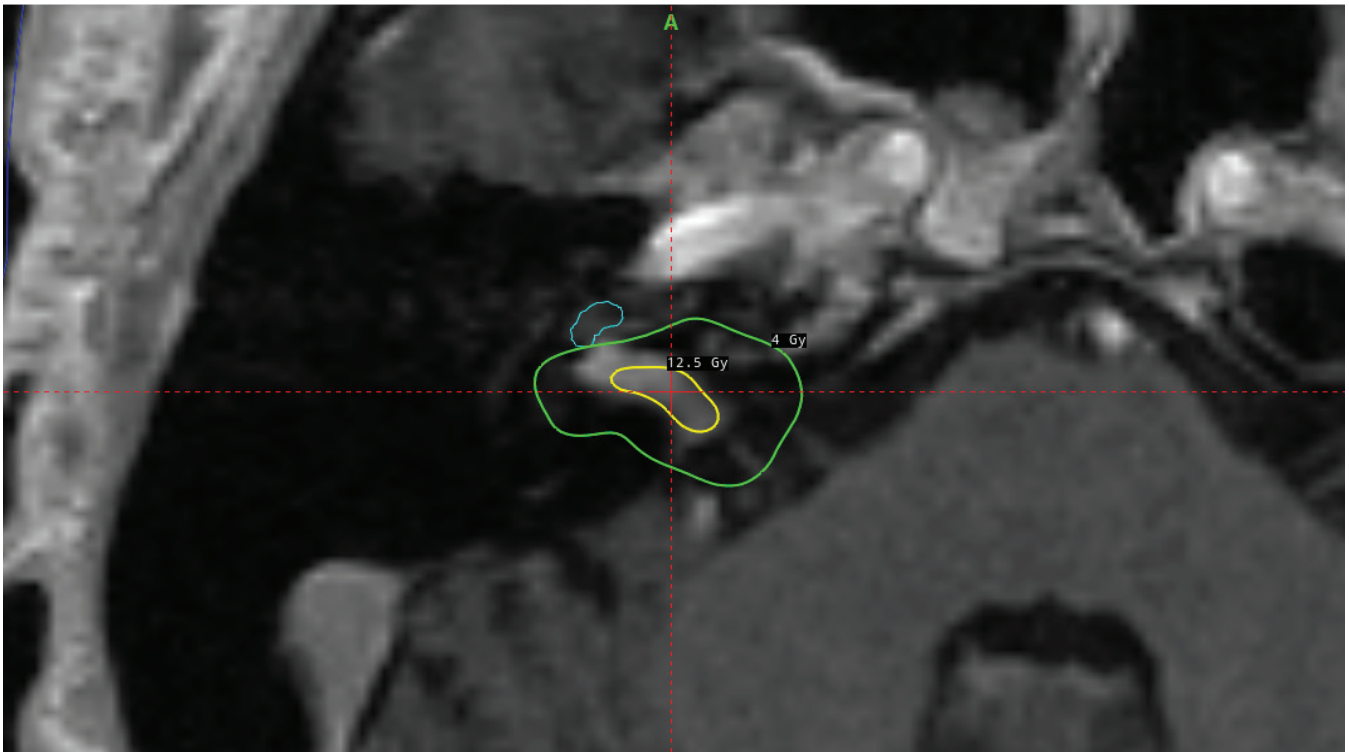


Figure 4a. Axial view.

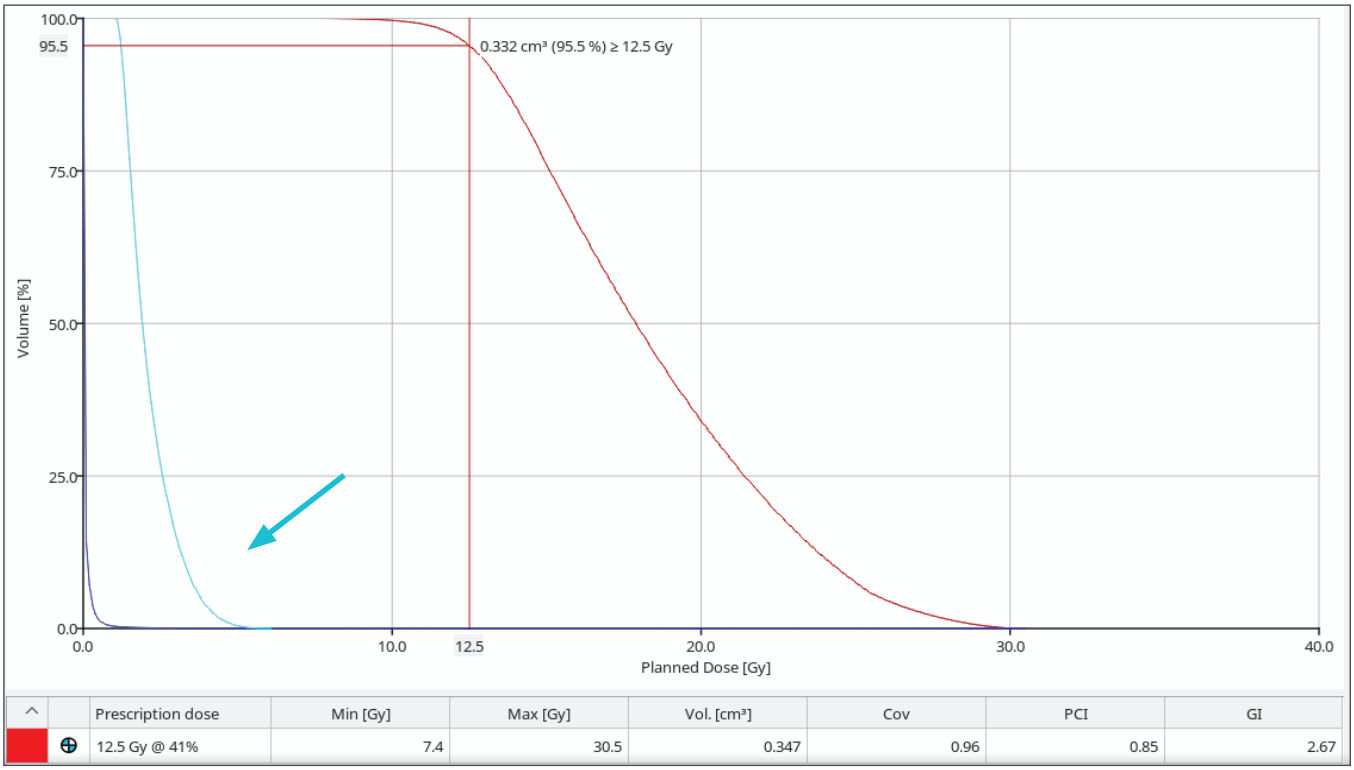


Figure 4b. Dose volume histogram.

Figure 5. Case example 2: Manual plan for a vestibular schwannoma

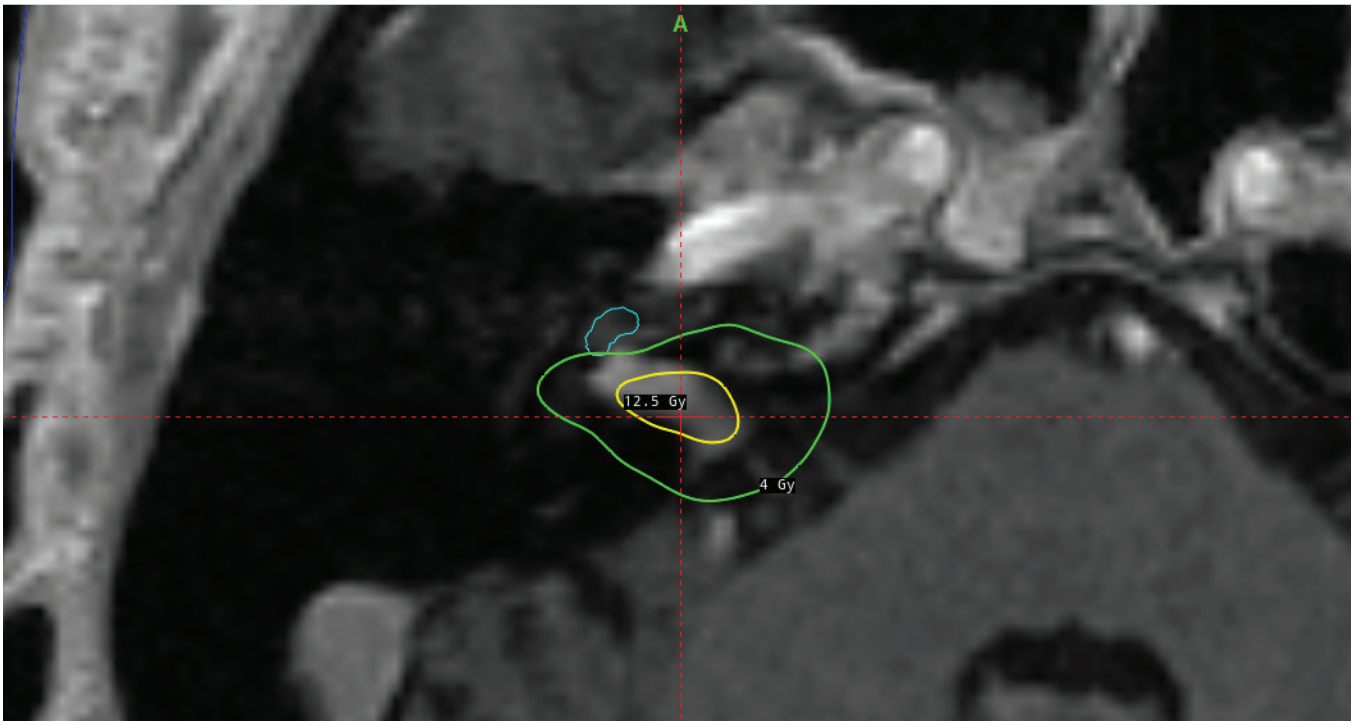
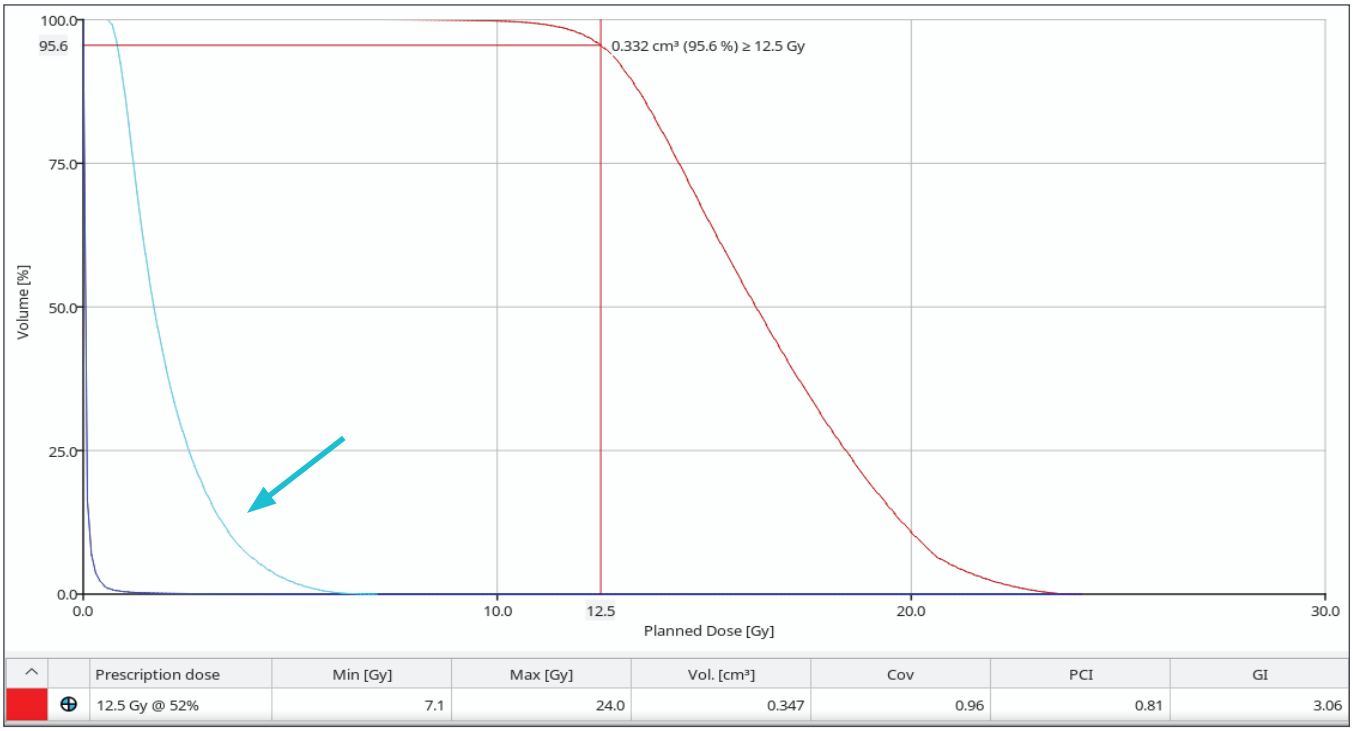


Figure 5a. Axial image.



Prescription dose	Min [Gy]	Max [Gy]	Vol. [cm³]	Cov	PCI	GI
12.5 Gy @ 52%	7.1	24.0	0.347	0.96	0.81	3.06

Figure 5b. Dose volume histogram.

Case example 3. Dual target AVMs

This patient was diagnosed with two arteriovenous malformations (AVMs). AVM cases involve additional imaging, with angiograms to import and define stereotactically within the planning system (Figures 6–7). With this extra burden on planning time, any efficiency gains are greatly appreciated.

"In this case, one AVM was tiny (target 1) and only needed a couple of shots, while the other larger AVM (target 2) required a bit more optimization to obtain good conformity to the target," Earner recalls. "For both targets, Lightning improved both PCI and coverage, which is impressive (Tables 3–5). Manual planning took 15–20 minutes compared to less than a minute with Lightning. Overall, Lightning was quicker and better."

The plans for each target obtained using Lightning and manual planning are shown in Figures 8–9.

Figure 6. Case example 3: Angiograms for AVM target 1.

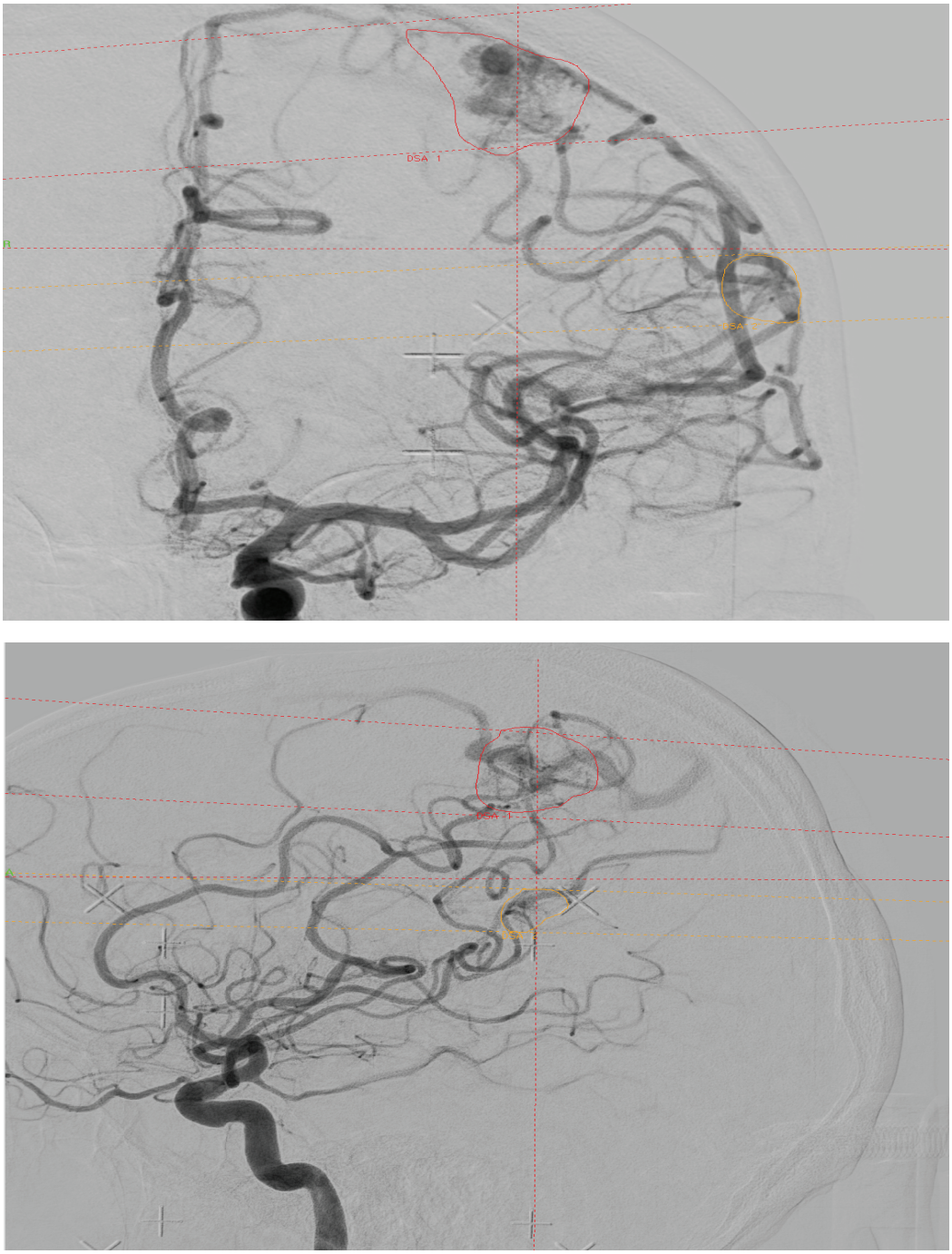
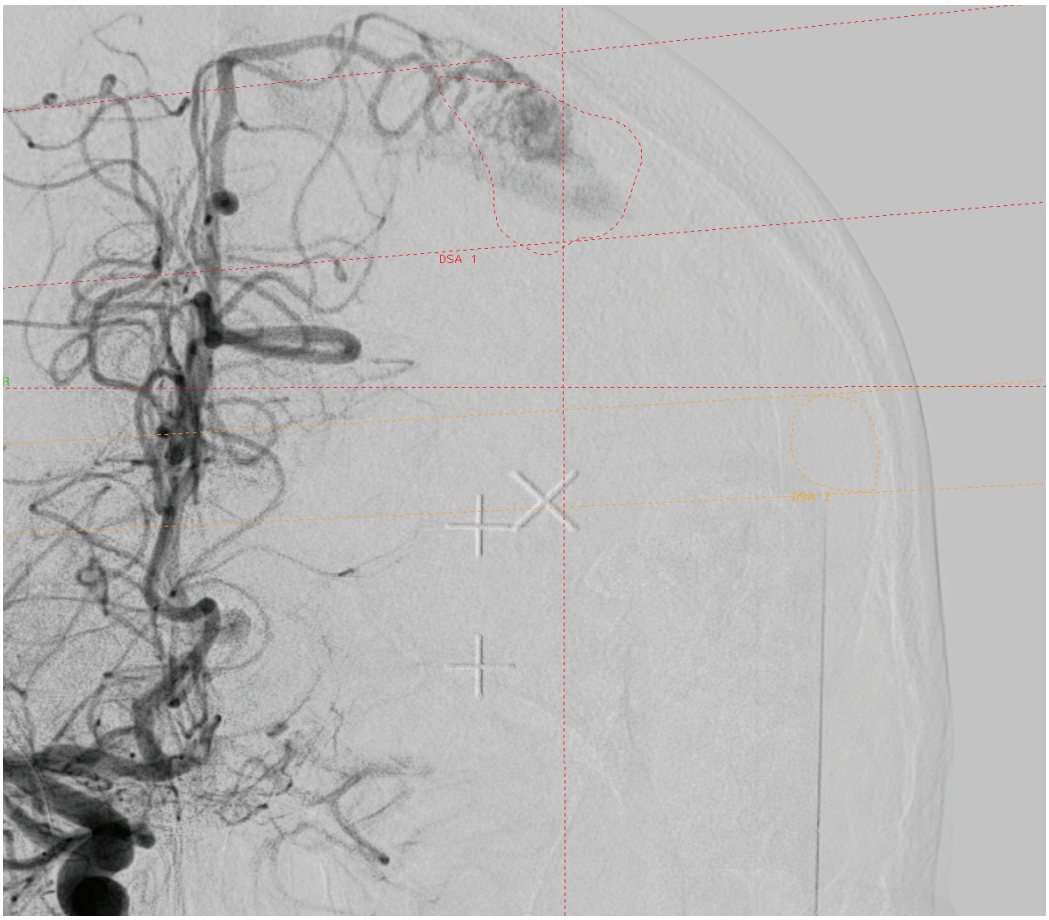
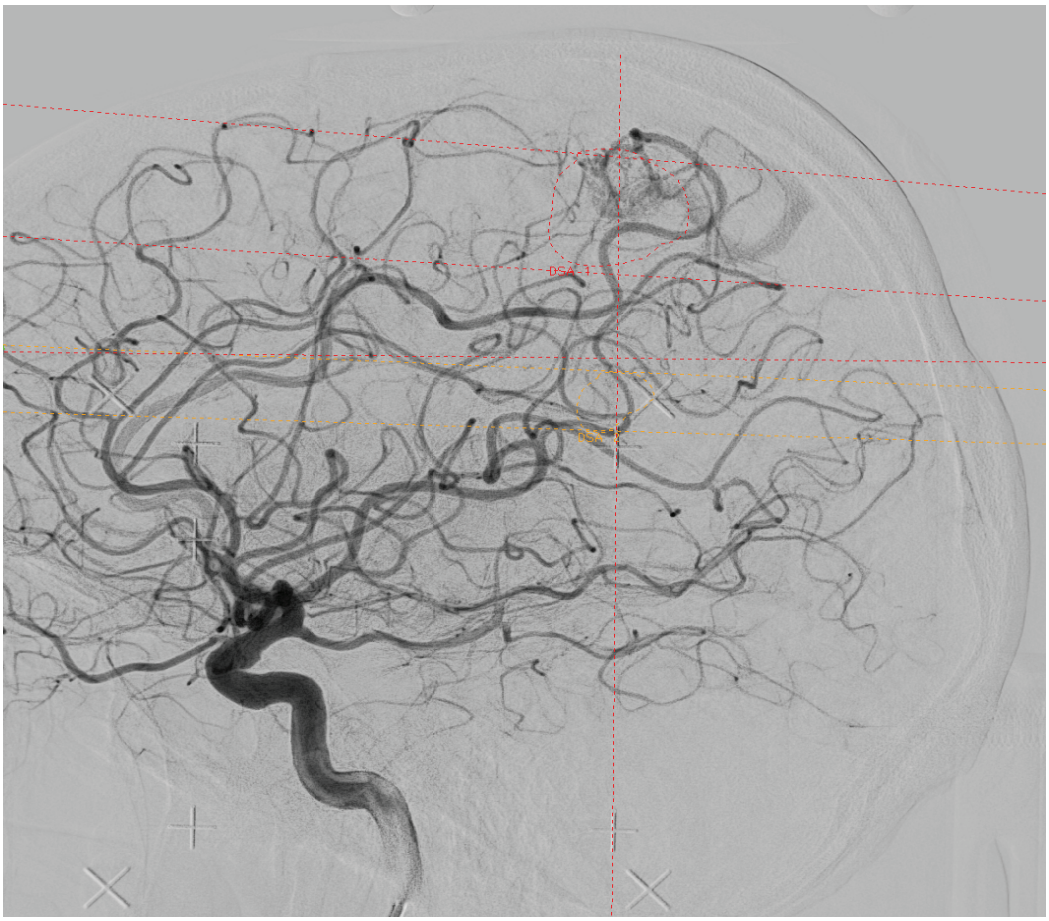


Figure 7. Case example 3: Angiograms for AVM target 2.





Case 3	Target 1					
	Isodose (%)	Coverage	PCI	GI	Min dose (Gy)	Max dose (Gy)
Manual	50%	0.95	0.68	3.41	17.2	50.0
Lightning	62%	0.97	0.73**	3.59	19.2	40.3

**Our target PCI of ≥0.85 is often not achievable for tiny volumes.

Table 3. Case example 3: Comparison of target dosimetric parameters for AVM target 1.

Case 3	Target 2					
	Isodose (%)	Coverage	PCI	GI	Min dose (Gy)	Max dose (Gy)
Manual	47%	0.97	0.88	2.59	17.2	53.2
Lightning	59%	0.98	0.89	2.67	20.8	42.4

Table 4. Case example 3: Comparison of target dosimetric parameters for AVM target 2.

Case 3	Delivery	
	BOT (mins)	Shots
Manual	87	21
Lightning	71	42

Table 5. Case example 3: Comparison of delivery parameters for AVM targets 1 and 2.

Figure 8. Case example 3: AVM target 1.

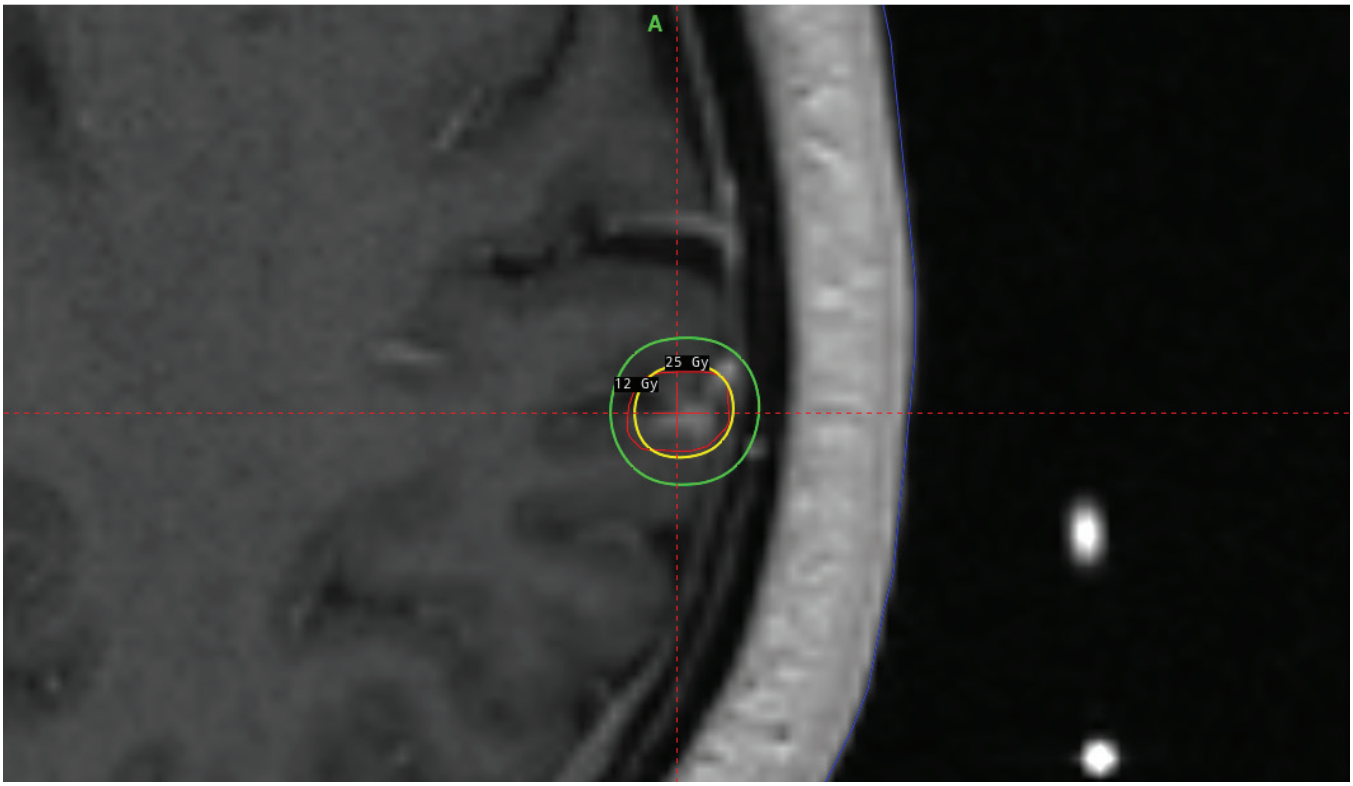


Figure 8a. Lightning plan for AVM target 1.

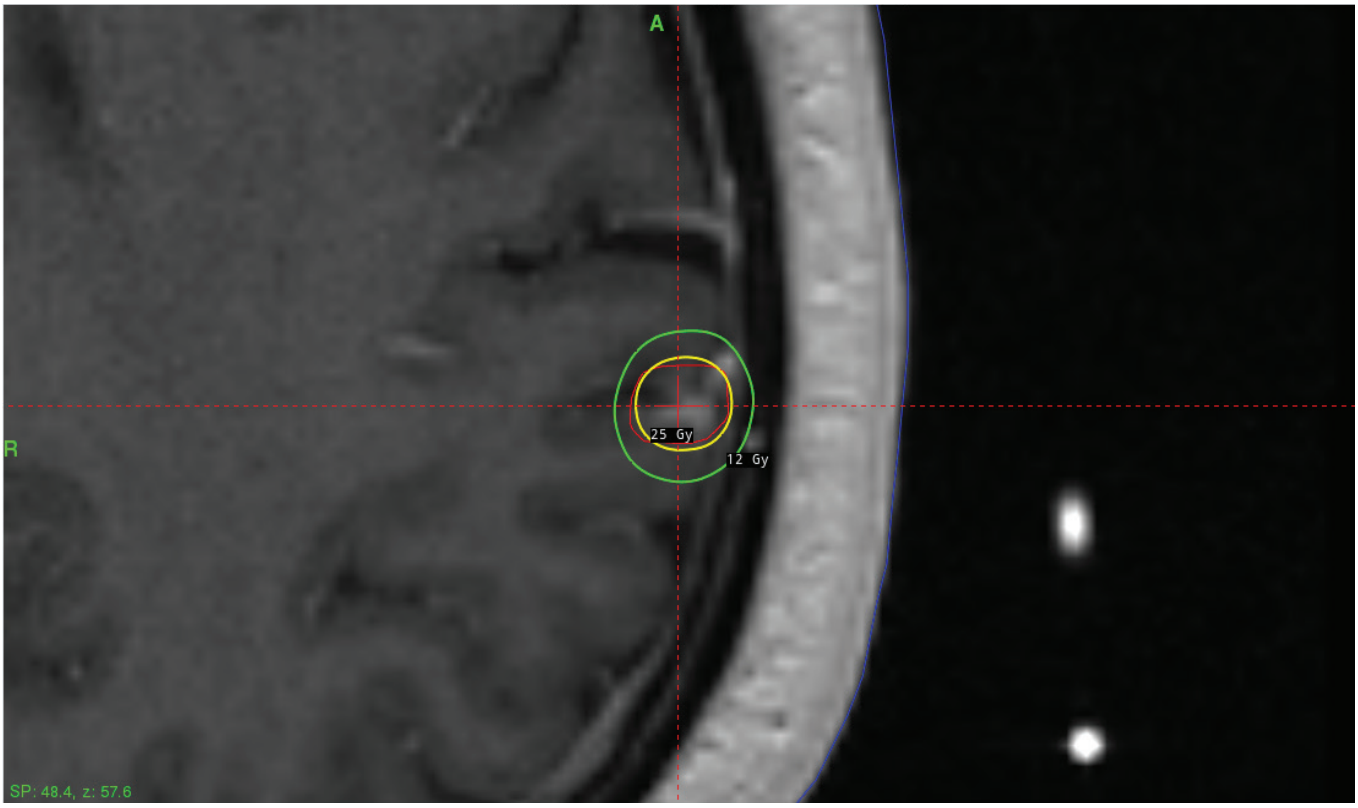
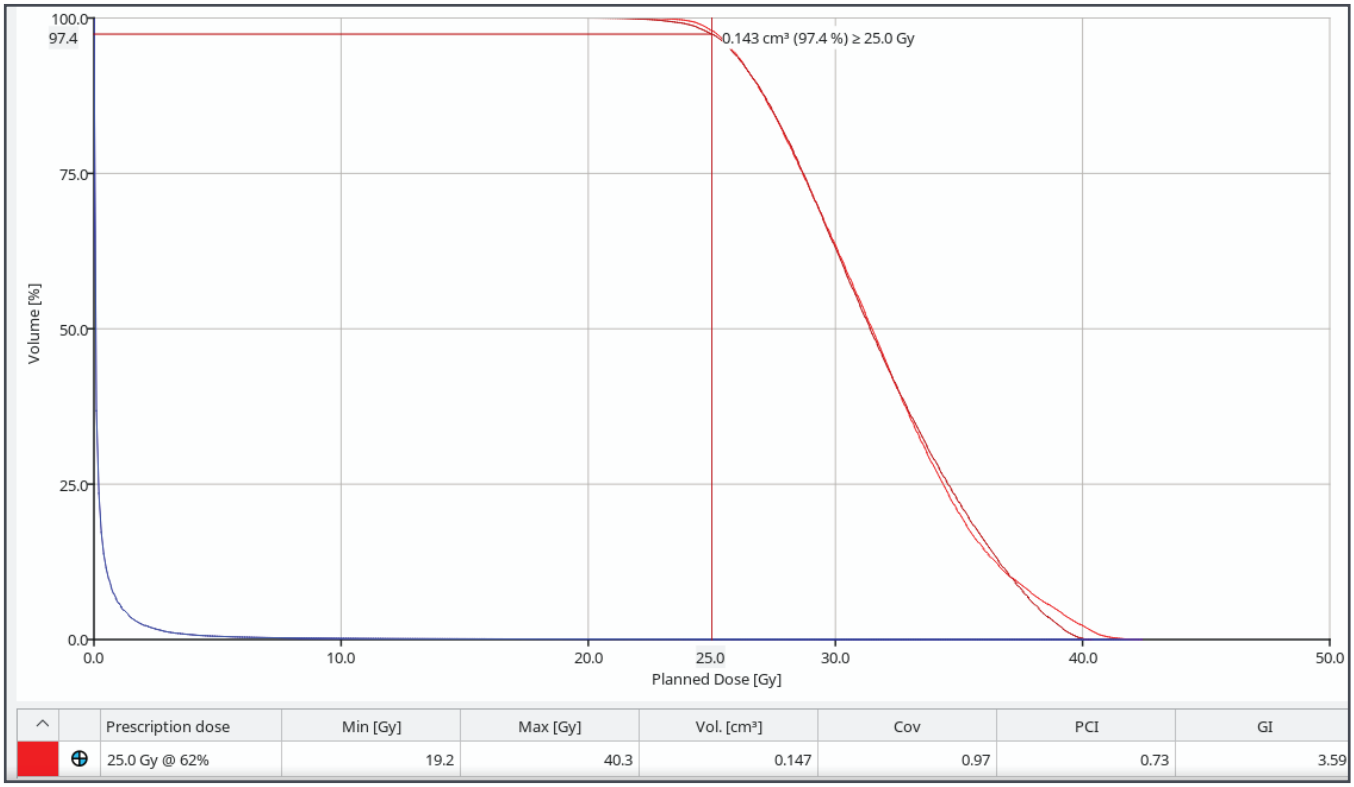
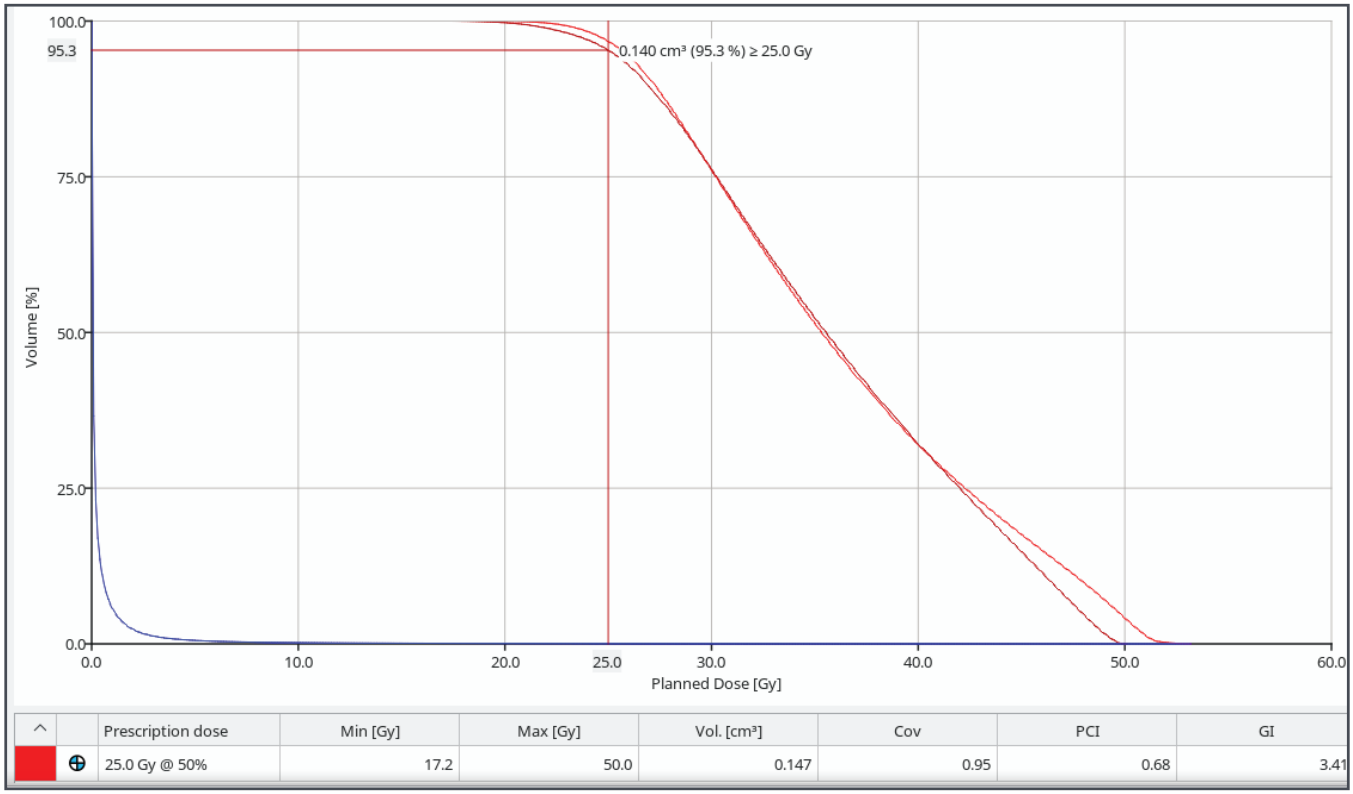


Figure 8b. Manual plan for AVM target 1.



	Prescription dose	Min [Gy]	Max [Gy]	Vol. [cm³]	Cov	PCI	GI
	25.0 Gy @ 62%	19.2	40.3	0.147	0.97	0.73	3.59

Figure 8c. Dose volume histogram of Lightning plan AVM 1.



	Prescription dose	Min [Gy]	Max [Gy]	Vol. [cm³]	Cov	PCI	GI
	25.0 Gy @ 50%	17.2	50.0	0.147	0.95	0.68	3.41

Figure 8d. Dose volume histogram of Manual plan AVM 1.

Figure 9. Case example 3: AVM target 2.

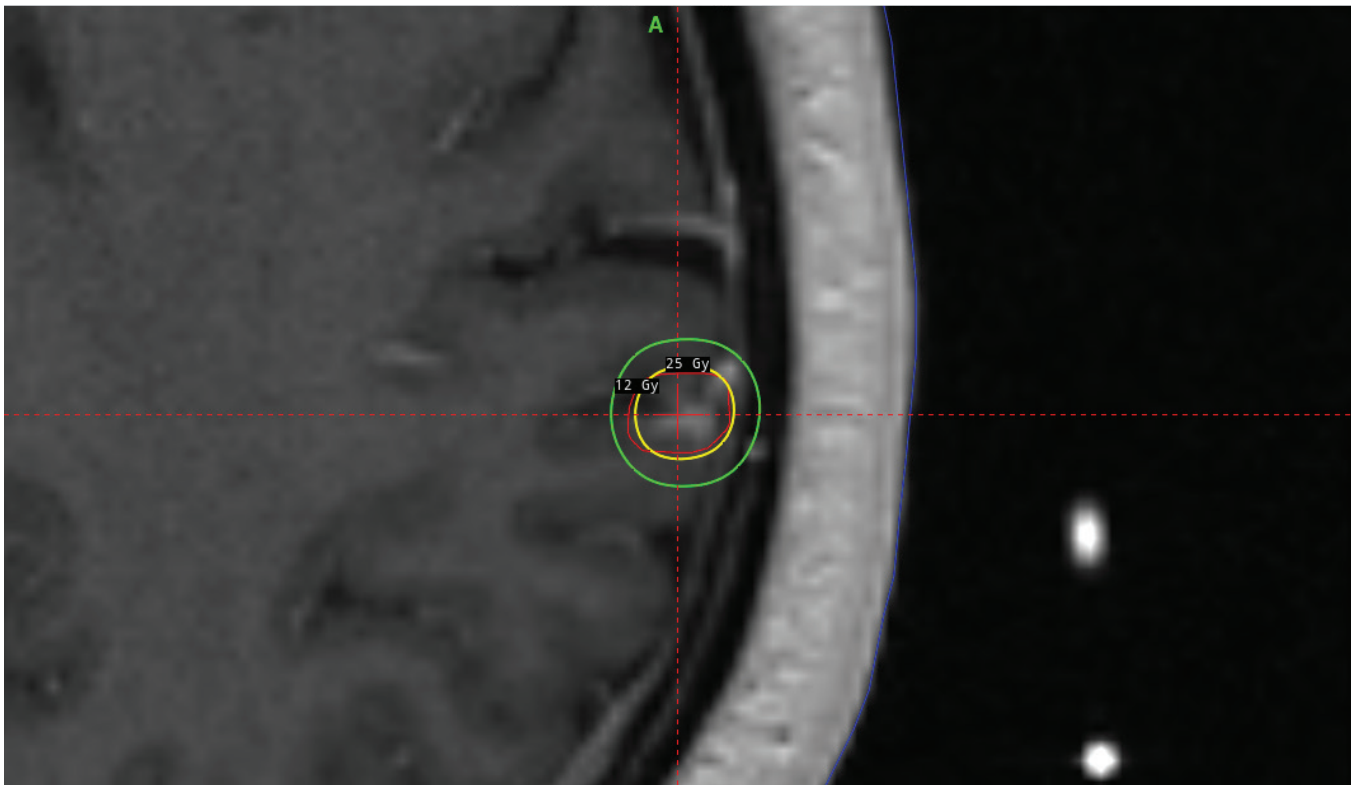


Figure 9a. Lightning plan for AVM target 2.

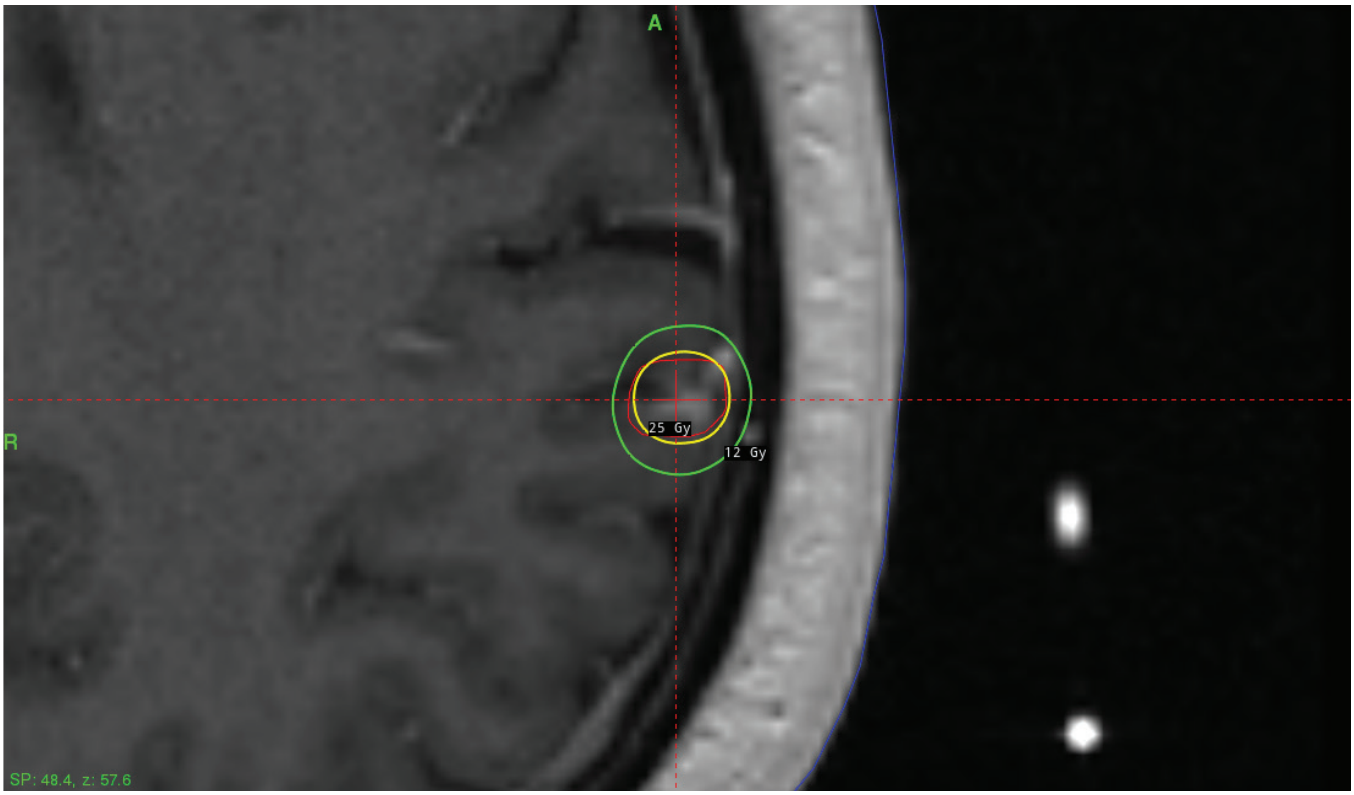
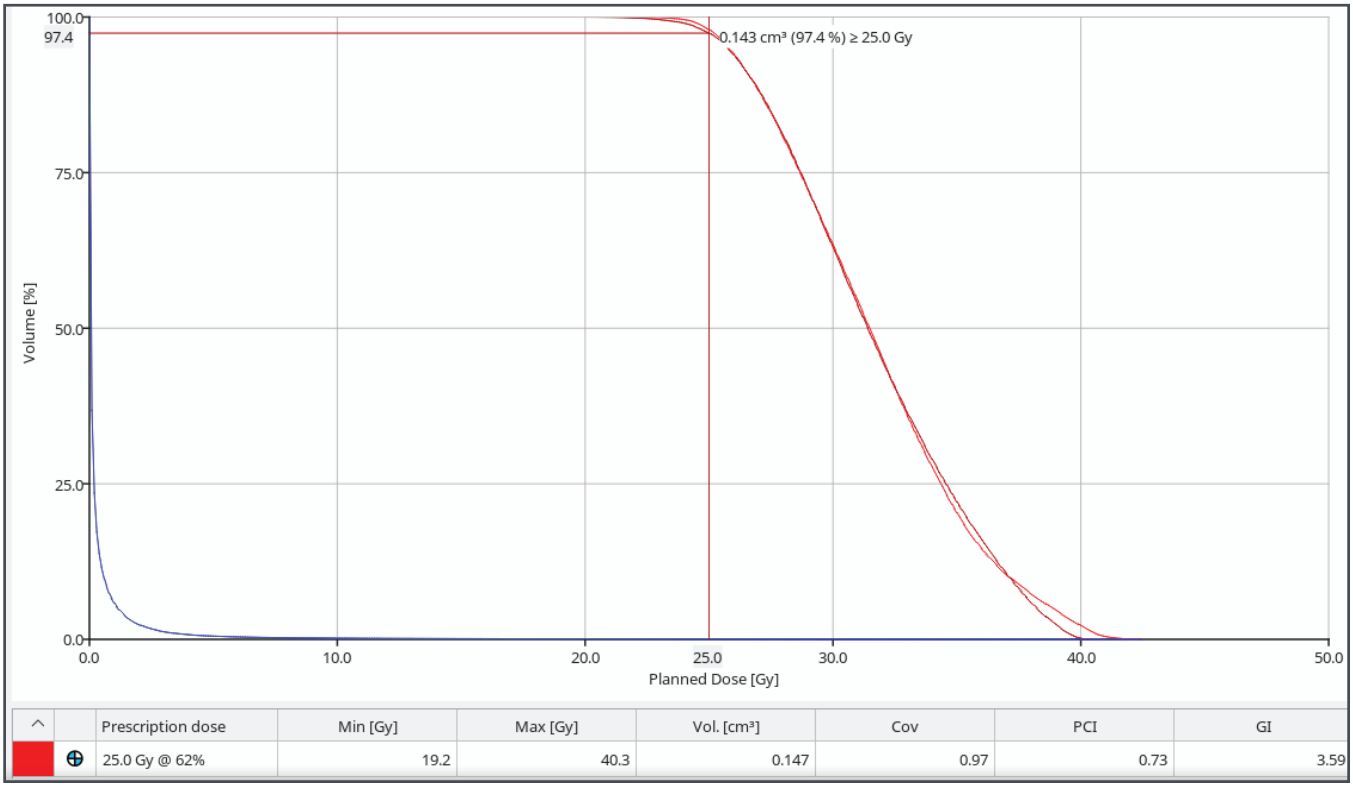
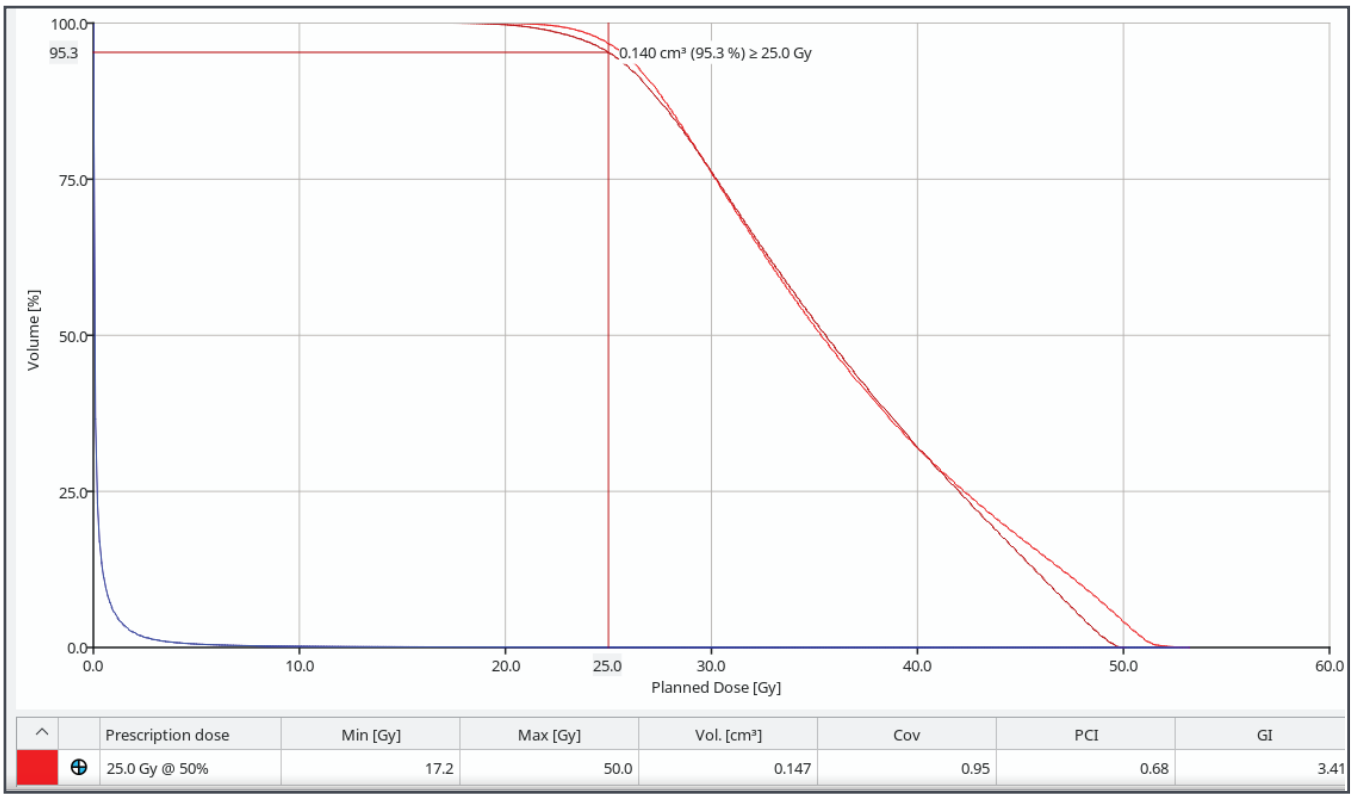


Figure 9b. Manual plan for AVM target 2.



	Prescription dose	Min [Gy]	Max [Gy]	Vol. [cm³]	Cov	PCI	GI
	25.0 Gy @ 62%	19.2	40.3	0.147	0.97	0.73	3.59

Figure 9c. Dose volume histogram of Lightning plan AVM 2.



	Prescription dose	Min [Gy]	Max [Gy]	Vol. [cm³]	Cov	PCI	GI
	25.0 Gy @ 50%	17.2	50.0	0.147	0.95	0.68	3.41

Figure 9d. Dose volume histogram of Manual plan AVM 2.

Improving planning quality and consistency

"For Lightning, the main impact on our department has been the improvement in planning consistency," Earner concludes.

> Not only is there better consistency between planners, but there's also an improvement in plan quality overall

In addition to this, it saves us a lot of time, which pleases everyone involved, whether that's the patient, the consultant, or the planner. I would be happy to recommend Lightning to other centers."

Disclaimer

This customer perspective is based on the experience and application of medical experts, and is intended as an illustration of an innovative use of Elekta solutions. It is not intended to promote or exclude any particular treatment approach to the management of a condition. Any such approach should be determined by a qualified medical practitioner.

As a leader in precision radiation therapy, Elekta is committed to ensuring every patient has access to the best cancer care possible. We openly collaborate with customers to advance sustainable, outcome-driven and cost-efficient solutions to meet evolving patient needs, improve lives and bring hope to everyone dealing with cancer. To us, it's personal, and our global team of 4,700 employees combine passion, science, and imagination to profoundly change cancer care.

We don't just build technology, we build hope.

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