Good afternoon, everybody.
Thank you all for coming.
It's my really true pleasure to introduce Sherry Dimas today.
She really is a leader, and we're so lucky to have her here at Yale University.
Sherry trained at Cornell and then did her residency at Memorial Sloan.
Kettering and joined us 11 years ago. She’s now professor of therapeutic radiology, and she.

It built our HDR brachytherapy service here at Yale, which is really an incredible accomplishment.

So today she’s going to be speaking to us about advances in treatment of cervical cancer and welcome Sherry.

Thank you so much, Joe, for that very kind introduction and for that very kind introduction and it’s really an honor to be here.

So as you heard, I direct the gynecologic radiotherapy program here at Yale and today I’m going to be talking about brachytherapy and
the treatment of cervical cancer, how we approach these patients and specifically the supportive and innovative programs that we have here at Yale for this unique patient population. And they have no financial disclosures. So cervical cancer is a global health problem. Worldwide, there’s more than 600,000 new cases per year and more than 340,000 deaths in 2020. And it’s particularly a problem in resource limited countries where it’s a very common type of cancer and a very common cause of cancer mortality.
And in certain regions of Africa and Central America, it’s actually the leading cause of cancer related mortality. Unfortunately this is a cancer that disproportionately effects women in low socioeconomic groups and there are complex challenges at every step in the cervical cancer continuum. In the United States, there’s more than 14,000 new cases per year and more than 4000 deaths expected in 2022. The highest incidence is among US Hispanic, black and Native American populations.
This is a cancer of young women. It is most frequently diagnosed in women ages 35 to 44. And as we all know, HPV is central to the development of cervical cancer. It causes more than 95% of cases. Risk factors include various sexual behaviors, including young age at first coitus, multiple sexual partners, history of STIs. It’s also more common among those with a compromised immune system. So fortunately, screening cervical cytology and
HPV testing has led to reductions in cervical cancer mortality, particularly in resource rich settings. And the incidence of cervical cancer is affected both by epidemiologic risk factors as well as by having access to screening programs. So for those who are screened, cervical cancer may be discovered asymptomatically and very early stages, for example because of an abnormal pap smear or if you know a visible lesion is discovered incidentally on a pelvic examination. But these are not the patients that I see in my practice.
So the types of patients that I might see in my practice are typically, let's say, a young woman in her 30s or 40s who has a very advanced cancer that's highly symptomatic. And she's probably had bleeding and pain going on for some time. She's perhaps bounced around between different emergency departments and different hospitals, misdiagnosed with fibroids or infection, and she's often from an underserved community. She is often suspicious of the medical student of the medical system.
and has not had routine screening.

She may even be suspicious of a GYN exam, perhaps a history of abuse or trauma in her past and often life hasn’t treated her well, and now she’s hit with this.

So this is locally advanced cervical cancer. That’s when the tumor has grown to be clinically visible more than 4 centimeters. It invades beyond the cervix into the parametrial tissues. It can extend out to the pelvic sidewall, down into the vagina, and can also extend into the surrounding structures of the pelvis,
Including the bladder or the and for these patients, the primary treatment is not surgery, but rather these patients are treated with chemo, radiation and brachytherapy. The paradigm for treatment is shown here and what I'm showing on the horizontal line is the time frame of treatment. So we try to get all of the treatments done within eight weeks. So for the first five to six weeks of treatment, the treatment consists of external beam radiation, which is what I'm going to show you.
These arrows can note weekly cisplatinum chemotherapy, which has been shown in randomized trials to improve the overall survival in this population. So the first five to six weeks are chemo radiation. That is followed by brachytherapy, which I’m going to talk about today. And again, all these treatments we tried to complete within eight weeks, studies have shown that. Sending treatment beyond eight weeks is associated with a reduction in tumor control and worse outcomes.
NOTE Confidence: 0.900395265
00:05:08.770 --> 00:05:10.482 I think many of you here are familiar
NOTE Confidence: 0.900395265
00:05:10.482 --> 00:05:11.589 with external beam radiation,
NOTE Confidence: 0.900395265
00:05:11.590 --> 00:05:12.523 also called evart.
NOTE Confidence: 0.900395265
00:05:12.523 --> 00:05:14.700 The patient comes every day to our
NOTE Confidence: 0.900395265
00:05:14.767 --> 00:05:16.645 department for five days a week.
NOTE Confidence: 0.900395265
00:05:16.650 --> 00:05:18.092 For five weeks she lies on a
NOTE Confidence: 0.900395265
00:05:18.092 --> 00:05:19.219 table that looks like this.
NOTE Confidence: 0.900395265
00:05:19.220 --> 00:05:21.062 This is called a linear accelerator
NOTE Confidence: 0.900395265
00:05:21.062 --> 00:05:22.964 that delivers high energy X-rays from
NOTE Confidence: 0.900395265
00:05:22.964 --> 00:05:24.806 the outside into a very carefully
NOTE Confidence: 0.900395265
00:05:24.806 --> 00:05:26.639 the outside into a very carefully
NOTE Confidence: 0.900395265
00:05:26.640 --> 00:05:28.386 designed target like what you see here.
NOTE Confidence: 0.900395265
00:05:28.386 --> 00:05:29.960 And this is a target that’s
NOTE Confidence: 0.900395265
00:05:29.960 --> 00:05:31.360 designed to incorporate the pelvic
NOTE Confidence: 0.900395265
00:05:31.360 --> 00:05:32.345 any lymph nodes that are
NOTE Confidence: 0.900395265
involved in the pelvis,

as well as the periaortic region,

which is a common area that’s involved with cervical cancer.

And specifically with MRT,

we’re able to deliver a very carefully designed field to the areas that are at risk and give much lower dose to any of the surrounding structures in the pelvis through a very carefully modulated beam. Again, we’re avoiding the bowel, the spine, the kidneys, the bone and the muscle. So we’re able to deliver this
type of treatment with much less toxicity than in the olden days.

Another advantage of IRT using the modulated beams is we’re able to deliver a high dose to the pelvic lymph node regions and deliver a dose of approximately 60 Gray while giving simultaneously a much lower dose to any of the surrounding tissues in the pelvis.

But for cervical cancer, what’s unique is that external beam radiation alone is not enough. The second-half of their treatment is delivered with brachytherapy,
also called internal radiation,
NOTE Confidence: 0.883967432
where we have to deliver a much
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higher dose to the central tumor,
NOTE Confidence: 0.883967432
really a dose of about 90 Gray.
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And really the only way to do
NOTE Confidence: 0.883967432
this is from inside the tumor,
NOTE Confidence: 0.883967432
not from outside.
NOTE Confidence: 0.883967432
So brachytherapy involves placing
NOTE Confidence: 0.883967432
radioactive source and direct contact
NOTE Confidence: 0.883967432
with the tumor to kill the rapidly
NOTE Confidence: 0.883967432
dividing cancer cells that are
NOTE Confidence: 0.883967432
surrounding it and cervical cancer.
NOTE Confidence: 0.883967432
This is done by placing a rod
NOTE Confidence: 0.883967432
inside the uterus and a ring
NOTE Confidence: 0.883967432
type structure in the vagina.
NOTE Confidence: 0.883967432
And through these applicators,
whether they’re plastic or metal,
we’re going to deliver a radioactive source that’s going to do well in these applicators.
And therefore deliver a much higher dose to the tumor and in doing so with a very steep dose gradient going to give a much lower dose to any of these surrounding tissues. So unlike other types of cancers where brachytherapy is seen as an option, but there are other similar efficacious options like asperity and protons and cervical cancer, that’s not the case.
There is no substitute for brachytherapy because these other modalities don’t allow us to achieve that very high steep dose gradient that I mentioned. But the thing about brachytherapy, it’s different than external beam, it’s interventional and it requires technical skill, but also specialized resources, different equipment, special applicators, and so not everywhere has it. Is this a study from 2013 from this year database which looked at cervical cancer patients with locally advanced disease who were treated.
with brachytherapy compared to those that did not receive brachytherapy. And you can see that the cause specific survival as well as the overall survival is significantly improved among those that had brachytherapy? This is a similar study from the NCDB in 2014, again more than 7000 locally advanced cervical cancer patients. And specifically asked the question is there how do patients who receive a different form of treatment to escalate those to the cervix such as SPRT, IRT compared to those who have brachytherapy. And again you can see that the
women that have brachytherapy have a significantly improved overall survival.

So here at Yale, I’m very proud to work with the dedicated team who assure highly coordinated and interdisciplinary care for these women. These pictures are just an illustration of some of the people who might help with any of these cases on a given day. So we work very closely with nurses in the OR in the pacu. We work with the technologists in the MRI suite within our own department. We have dedicated dosimetrists, and we have radiation therapists who are intimately involved in our cases.
dedicated nursing staff, physics, and we have faculty. Within our own department, as well as faculty within the Joanne Oncology department that we work very closely with, for all of these cases, we work with coordinators, administrative assistance, nurses, residents, fellows from all these different departments listed here. These folks are not only committed to delivering high quality brachytherapy with safety and excellence, but what stands out to me is the
compassion that they show and caring for the whole patient and understanding that this is a unique population. A treatment that can be painful, upsetting or even traumatic for patients and requires a recognition of that as well as an interpersonal touch. The good news that I’m going to share with you today is that there has been tremendous technological advances in the field of brachytherapy over the past 10 to 15 years, and I am grateful for the support of my department, the hospital and the Cancer Center for recognizing the
benefits that these provide.

Today what I'll be talking about is how breakey therapy evolved to modern MRI guided adaptive technique.

I'm going to discuss the role of 3D printing and innovation and directions for future.

I'm going to discuss training the next generation of brachytherapy providers with simulation based education.

And finally, I'll discuss the resources that we have here at Yale to help assure that these women go on to live normal lives after cancer treatment,
that can be associated with such treatments.

So how did we get here?

So one of the things that drew me to the field of radiotherapy was the technological advancements.

And while that’s for sure true and well known within our external beam treatments and MRT, it hasn’t always been the case with brachytherapy.

So there was a period of about four or five decades, I would say between the 1960s and early 2000s were brachytherapy really looked like this.

It was kind of the same.
This is called an intrauterine tandem that was placed inside the uterus, inside the operating room and this is called a vaginal ovoid. And two of these would be placed on either side of the cervix. We would do this under anesthesia while the patient was in the operating room to surround. These are metal applicators that would surround the cervix. They would get packed into place and we would take an image of these applicators through these.
Replicators.

We would then load cesium sources to give off a cloud of radiation.

So cesium sources came in different strengths and our physicists would figure out how much cesium and where inside these applicators to place them to create a symmetrical pear shaped distribution that looks like this. So we had mathematical formulas and lots of decades of data to know what type of dose we needed to get to these different points in relation to the applicators to achieve good outcomes local control of about 75%

In the mid 2000s things began
improving in the planning, optimization and treatment delivery.

We had newer applicators that were compatible with an HDR source. So basically the applicators, they were kind of the same idea tandem. This is called a ring which sits in the vagina, but after placing it, packing it, designing radiation plan rather than having a patient have to stay in the hospital. So with cesium the patients would be admitted.

In order to give off the dose cloud that was necessary,
the patient would have to be admitted to the hospital for 48 to 72 hours.

With a decaying radioactive source inside of them.

The benefit of an HDR source which is Iridium, is that the same treatment can be delivered in a course of about 10 minutes and it can be done in an outpatient setting in a brachytherapy suite. So we could place the applicators, design the radiation plan and treat them in a brachytherapy suite over a period of about 10 minutes. Once the treatment was done they could go home.
Another benefit of the applicators is that rather than just imaging them with a plain film, they were CT compatible. So that allowed us to not only see the applicators but actually see the nearby organs, the sigmoid bladder, the bowel, and we were still aiming for that symmetrical pear shaped distribution, but we were able to optimize the dwell times and sort of shrink the dose a little bit off of the surrounding organs and therefore give much lower...
00:12:38.051 --> 00:12:39.796 dose to the surrounding organs.
NOTE Confidence: 0.825945304
00:12:39.800 --> 00:12:42.293 And it turns out that had a big benefit.
NOTE Confidence: 0.825945304
00:12:42.300 --> 00:12:43.728 This was shown in the stick trial
NOTE Confidence: 0.825945304
00:12:43.728 --> 00:12:45.212 which was a prospective but not
NOTE Confidence: 0.825945304
00:12:45.212 --> 00:12:46.850 randomized trial of about 800 women
NOTE Confidence: 0.825945304
00:12:46.850 --> 00:12:48.668 with locally advanced cervical cancer.
NOTE Confidence: 0.825945304
00:12:48.670 --> 00:12:50.560 And basically compared those that had
NOTE Confidence: 0.825945304
00:12:50.560 --> 00:12:52.426 the film based treatments to those
NOTE Confidence: 0.825945304
00:12:52.426 --> 00:12:54.076 that had CAT scan based treatments,
NOTE Confidence: 0.825945304
00:12:54.080 --> 00:12:56.320 SO3 dimensional seeing the organs.
NOTE Confidence: 0.825945304
00:12:56.320 --> 00:12:58.077 And you can see that local control
NOTE Confidence: 0.825945304
00:12:58.077 --> 00:12:59.599 in both groups was very good,
NOTE Confidence: 0.825945304
00:12:59.600 --> 00:13:01.390 about 75% like I mentioned.
NOTE Confidence: 0.825945304
00:13:01.390 --> 00:13:03.454 But the main advantage of switching
NOTE Confidence: 0.825945304
00:13:03.454 --> 00:13:04.892 to 3/3 dimensional imaging was
NOTE Confidence: 0.825945304
00:13:04.892 --> 00:13:06.257 there was a significant decrease
in grade three to four toxicity. So in the film based era the likelihood of having bowel obstruction and perforation bleeding fistula was about 20 to 25% whereas once you see your organs and you, you know, optimize your beam accordingly. Now the likelihood of grade 3 or 4 toxicities only two to 3%. So that was a big advantage. The next advancement came in the mid 2000 tens, really pioneered in Europe by a group of researchers.
And what they sought to do is to incorporate MRI to improve the way we do brachytherapy and to improve local control. And really this group created a renaissance in the cervical brachytherapy community by incorporating MRI into treatment planning.

So MRI has always been an important diagnostic imaging modality for cervical cancer. We always get an MRI up front at the time of staging to help determine the local extent of the tumor, if there’s any involvement of the vagina,
the uterus, the parametrium, the surrounding structures.

And even in the LDR era, we would often get a pre brachytherapy MRI after about five weeks of radiation. This is a rapidly growing tumor, so it responds rapidly to radiation. It can shrink by about a centimeter per week. So getting an MRI before brachytherapy would give us information about how much of the tumor is left and also the dimensions of the uterus prior to going to the operating room. But the embrace trial took it one step further and said we could design
applicators that are MRI compatible.

We can do the procedure like we’ve done place the applicators but now instead of going to CAT scan we can go to MRI and that now we can actually see the cervix in relation to the applicator and see the tumor in relation to the applicator and change the way that we prescribe radiation different from how we’ve done it for decades. So I mentioned for decades we were looking for this type of pear shaped distribution aiming to get radiation to a certain point from the applicators but with this.

Anyway,
they through they designed very carefully thought out and develop principles to allow us to deliver dose to the residual cervix and the remaining tumor as seen on MRI. So lots of institutions began adopting this approach and they presented their retrospective outcomes. And you can see here that there was significant improvement in local control when you look at these individual institutional studies looking like local control was now about 90% or higher. So this looked really good and still very low toxicity.
The embrace trialists went on to develop a series of prospective studies following over 1000 women and collecting patient reported outcomes and validated toxicity information, looking not only how to optimize the way that we prescribe the dose to the tumor, but also seeking to reduce any treatment related morbidity and how to optimally constrain the dose to the normal tissues. And they put out very high impact papers showing us how we could monitor the dose to the rectal morbidity. How to decrease dose of the bladder.
and keep the bladder morbidity low.

And they even put out data for how to limit dose to the vagina to produce less vaginal toxicity for these patients.

So with all of this mounting evidence here at Yale, we were able to establish an MRI based program at around 2016 or 2017. And in order to have an MRI based program you need to have access to an MRI. So some radiation departments have an MRI simulator in their department. We do not. So like others we partner with the MRI that’s available in our diagnostic imaging suite. You need to invest in MRI safe applicators,
you need to meet with our radiology colleagues to develop proper sequences and protocols for imaging and you have to study the concepts.

From the get Castro and embrace how to do these target volume delineation, you have to invest in an MRI safe transport system because you’re placing applicators in the operating room and now you’re taking them to the MRI.

You have to have trained staff and you have to have integrated MRI safety procedures, patient questionnaires and procedural checklists.
So all of this, this has been our standard way for treating cervical cancer patients for the past six or seven years. And this is what in modern MRI intracavitary tandem and ring plan might look like. You can see that the dose is very concentrated on the cervical tissue due to the physical proximity of the source to the tumor. There’s a very steep dose gradient. So none of this high dose is going to any of these surrounding organs. This looks a little bit different.
than the old fashioned film and point based plans that I showed you.  
But I will mention here that because of the sort of simplicity of the applicators tandem and ring, you still have a symmetric dose distribution.  
But the more you start visualizing your tumors on MRI, your tumors on MRI, the more you realize that not every tumor is symmetric and also not every tumor is going to be perfectly covered by one of these symmetric dose distributions.  
So depicted here in blue is a tumor and in red is the 100% dose that I'm trying to give.
And you can see that they’re aspects of this tumor in blue that are extending outside of the red. So that is with sort of pushing our dose the best that we can with our intracavitary applicator, whereas an ideal coverage depiction might look like this where the entire tumor is covered in the red. So it turns out that if you take your standard intracavitary applicator tandem and ring and you add what are called interstitial needles that look like this thin plastic needles. If you add a couple of these
needles into the tumor to the parts of the tumor that are extending beyond the boundaries of what you would expect to be covered with a standard intracavitary plan, then you could significantly improve the dose coverage. And this is the birth of the so-called hybrid approach, which is basically that it’s saying that for tumors which you know are larger and might not be well covered with an intracavitary plan, you can add a couple of needles and thereby improve the dose coverage and more and more places started doing this.
In fact vendors came up with hybrid applicators that look like this. So again like a tandem and ring, but within the ring applicator there are holes that allow you to thread interstitial needles. So an example of the benefit of this approach is illustrated here. This was a young woman with a very large cervical tumor, stage 3B invading into the left pelvic sidewall. She had a very large tumor that responded well to external beam radiation, but she still had a significant...
amount of tumor that was present at the time of brachytherapy.

If she were to be treated with Intracavitary alone, you would have this circular symmetric dose distribution around the tandem. What you can see here is this is covering the anterior aspect of her tumor, but she still has tumor which is sitting laterally and. Posterior to this dose distribution. So what you could do and probably what you should do would be to increase the amount of radiation you’re putting in the tandem to better cover the tumor target.
Here you can see now we’re covering that lateral and posterior aspect of the tumor. But because of the nature of these intracavitary applicators are simultaneously increasing dose anteriorly to the bladder and that’s going to result in an increased risk of bladder morbidity. So the benefit of these hybrid applicators is that rather in a case like this, you could thread needles into the lateral and posterior aspect of her tumor, which is what we did. And then you can shape the dose distribution more like this.
pull that dose posteriorly to cover the target and actually simultaneously reduce the dose going to the bladder and pull the dose back to create this asymmetric target.

So what this graph shows is something that I think a lot of departments have seen, but once you introduce MRI, you suddenly go from IT department where you’re doing almost no interstitial procedures to very quickly finding that about 50% of your cases are being done with interstitial needles. So I think these days, customizing dose distributions on a per patient basis,
we are doing this more and more.

We're no longer aiming for that perfect pear shape,

just dosimetry that I showed you earlier and that we did for so many decades.

And maybe this seems simple for those of you in the audience, right, we're adding needles,

more degrees of freedom.

And yet the truth is there's a very steep learning curve within the breakthrough therapy community and it does take time for these new concepts to catch on.

And that might be because
by training and by nature, many of us in radiation oncology. Not interventionalists, but also sometimes there’s inertia and changing the way that you’ve done things for decades, and also there’s training and resources that are required to invest in these types of new procedures. So how common are MRI and interstitial? So this is a American breakey therapy practice survey from 2014. So it’s a little bit older, but it showed that between 2007 and 2014, MRI use increased to about 34% of practices. So probably nowadays that would be more.
And a 2020 Canadian Practice Survey found that between 2015 and 2020, interstitial use increased. That’s the use of needles increased to about 70% of practices. So more and more places are doing this. But not everywhere and currently we are the only place in Connecticut that does MRI guided interstitial brachytherapy. So we do see a lot of referrals from around the state. This is an example of a 73 year old who had a stage 3A cervical cancer with vaginal involvement. So she was treated with pelvic
00:22:04.360 --> 00:22:05.850 radiation and an outside hospital.
NOTE Confidence: 0.891907318
00:22:05.850 --> 00:22:07.368 But because of the extent of
NOTE Confidence: 0.891907318
00:22:07.368 --> 00:22:08.127 her vaginal involvement,
NOTE Confidence: 0.891907318
00:22:08.130 --> 00:22:10.111 she was not going to be properly
NOTE Confidence: 0.891907318
00:22:10.111 --> 00:22:10.960 treated with intracavitary
NOTE Confidence: 0.891907318
00:22:11.010 --> 00:22:12.655 radiation and so she was sent here
NOTE Confidence: 0.891907318
00:22:12.655 --> 00:22:13.890 for her needle placement,
NOTE Confidence: 0.891907318
00:22:13.890 --> 00:22:15.514 which you can see here in order
NOTE Confidence: 0.891907318
00:22:15.514 --> 00:22:16.837 to better cover this vaginal
NOTE Confidence: 0.891907318
NOTE Confidence: 0.874844722105263
00:22:20.000 --> 00:22:22.112 This is a 41 year old from an
NOTE Confidence: 0.874844722105263
00:22:22.112 --> 00:22:23.871 outside hospital who had a very
NOTE Confidence: 0.874844722105263
NOTE Confidence: 0.874844722105263
00:22:25.340 --> 00:22:27.070 It was invading into local
NOTE Confidence: 0.874844722105263
00:22:27.070 --> 00:22:28.454 organs in the pelvis,
NOTE Confidence: 0.874844722105263
00:22:28.460 --> 00:22:30.196 but it was also extending very laterally.
So you can see here what her dose distribution looked like. If she were treated with just tandem and ovoids, her dose distribution would be more narrow. So we added needles to extend her dose out laterally to the side walls of the pelvis. This was a woman who had a very bulky cervical tumor that had a lot of bulk and also intrauterine extent at the time of brachytherapy. So she benefited from this Vienna applicator for dose escalation to her tumor. And this is a young woman that had
00:22:57.460 --> 00:22:59.263 had a prior early stage cervical cancer treated with a hysterectomy
NOTE Confidence: 0.874844722105263
00:23:00.933 --> 00:23:02.492 and developed a vaginal recurrence mainly on the left side of her vagina.
NOTE Confidence: 0.874844722105263
00:23:02.492 --> 00:23:05.042 She would not have benefited from asymmetric dose distribution,
NOTE Confidence: 0.874844722105263
00:23:08.632 --> 00:23:10.652 but rather she needed needles preferentially in the left 4 necks of her vagina.
NOTE Confidence: 0.874844722105263
00:23:07.420 --> 00:23:08.632 asymmetric dose distribution,
NOTE Confidence: 0.874844722105263
00:23:12.212 --> 00:23:13.300 In order to give the proper dose.
NOTE Confidence: 0.869504395
00:23:13.300 --> 00:23:14.889 So as we use more needles,
NOTE Confidence: 0.869504395
00:23:17.650 --> 00:23:20.188 we realize that with MRI,
NOTE Confidence: 0.869504395
00:23:14.889 --> 00:23:16.446 it’s helpful not just to sort of place everything in the operating room and then go to MRI post facto
NOTE Confidence: 0.869504395
00:23:20.190 --> 00:23:21.830 we realize that with MRI,
NOTE Confidence: 0.869504395
00:23:21.830 --> 00:23:23.818 it’s helpful not just to sort of place everything in the operating room and then go to MRI post facto
NOTE Confidence: 0.869504395
00:23:23.818 --> 00:23:25.251 and what you get is what you get,
but rather to use the MRI, especially for complicated cases to actually help guide the needles. So we do that with iterative T2 sequences. So we’ll bring the patient while they’re under anesthesia to the MRI, they’re under anesthesia to the MRI, place our needles the best we can. And if we need to make adjustments, we’ll advance further deeper into the pelvis. Take another T2 sequence until we’re happy with the needle adjustments. So this is kind of more of an MRI guided approach and in addition to everything that I told you you needed for an MRI based program here.
you also need to have access to an MRI, excuse me to an anesthesia team available at the MRI which we are lucky to have here. We need to request extra time in the MRI suite because we're going to be taking multiple scans. We need time to make adjustments and this also requires another level of care coordination between the OR anesthesia imaging, pacu, GYN, oncology etcetera. We reserve these for our most complex. So that is our current state of MRI at this time.
in terms of some research, there's research ongoing at Johns Hopkins led by Doctor Akila Viswanathan, to try to improve the efficiency of the MRI procedure by developing kind of MRI tracking devices that allow you to see the needles as you're placing them in real time. So who knows, maybe this will be the state of the field soon. So all of this time and effort and attention to detail is it worth it. So the data shown here would say that it is especially for the larger tumor targets. The larger that your tumor is,
the more importance getting that proper dose is in order to achieve local control. So basically giving covering your tumor better is directly correlated with controlling your tumor better. And another advantage by doing these asymmetric dose distributions and, you know, pulling the dose off of the surrounding tissues as you’re giving a lower dose to the surrounding organs and causing less morbidity. And now all of this has been shown prospectively in the embrace one trial which was published last year in Lancet Oncology which was the first large scale prospective study testing all these
00:25:33.240 --> 00:25:35.040 concepts of MRI guided brachytherapy.
00:25:35.040 --> 00:25:36.168 It accrued patients from 24 centers in Europe,
00:25:37.300 --> 00:25:39.628 Asia and North America more than 1400 patients between 2008 and
00:25:39.628 --> 00:25:41.352 2015 and results were reported at a median follow-up of 51 months.
00:25:43.008 --> 00:25:44.859 The main finding was that five year local control was excellent 92%.
00:25:46.834 --> 00:25:50.590 What was especially impressive about these results is that this 92% local control was not just in the
00:25:52.340 --> 00:25:54.320 stage one and two smaller tumors, but was true across the board.
00:25:57.570 --> 00:25:59.190 Even in the stage three and four tumors,
these very large and infiltrative tumors still had excellent local control. Especially when we think back to the 75% that we sort of assumed in the olden days. They looked at overall survival at five years which was 74%. There is no direct comparison, but by looking back at it traditional cohorts, that’s an improvement by almost 7 to 10%. There was significant reduction in dose to the surrounding organs, 50% decrease in major morbidities and five year incidence of a Grade 3 or higher toxicity on a per organ basis was about 3 to 9%. 
So these are all very positive outcomes for our patients. So what comes next? So I mentioned that for decades it seemed like the field of brachytherapy was a little bit sleepy and there wasn’t much room for change. And yet here we are now in 2023, and I feel like the way we do brachytherapy is ever improving. It’s getting more customized. And I think the future looks bright. And part of that is because of 3D printing.
little bit different and breakey therapy

lets us get up close and personal.

So the better that you do

this on a per patient basis,

the better her outcomes will be.

But unfortunately,

the regulatory system and industry are

not always catching up fast enough.

And although I showed you some of the

modern equipment that we have available,

it can take almost a decade for

a new device to come to market

and to be FDA approved.

And it’s not particularly

profitable for the device companies

because at the end of the day,
it's just a small group of US specialized users who are doing these treatments.

So a lot of the technological advancements nowadays is grassroots and ground up and led by the doctors. And maybe this is fortunate because it's forcing the people who know the field the best to innovate.

So we're seeing a rising interest in 3D printing for brachytherapy because it allows customization, low cost and convenience. So this was one of the first published examples of a 3D printed customized ring applicator to guide flexible
00:27:53.973 --> 00:27:55.499 needles into a complex target.

NOTE Confidence: 0.919944976

00:27:55.500 --> 00:27:57.324 So you can see this is a cervical

NOTE Confidence: 0.919944976

00:27:57.324 --> 00:27:58.868 cancer which is extending to the

NOTE Confidence: 0.919944976

00:27:58.868 --> 00:28:00.416 sidewall and also to the vagina.

NOTE Confidence: 0.919944976

00:28:00.420 --> 00:28:02.076 Looking at this case up front,

NOTE Confidence: 0.919944976

00:28:02.080 --> 00:28:03.361 you kind of know this case is

NOTE Confidence: 0.919944976

00:28:03.361 --> 00:28:04.729 going to need at least you know,

NOTE Confidence: 0.919944976

00:28:04.730 --> 00:28:06.898 10 needles or so to properly cover it.

NOTE Confidence: 0.919944976

00:28:06.900 --> 00:28:08.745 So one way is to go to the operating

NOTE Confidence: 0.919944976

00:28:08.745 --> 00:28:10.438 room and freely place these needles

NOTE Confidence: 0.919944976

00:28:10.438 --> 00:28:12.195 and hope that your needles don’t

NOTE Confidence: 0.919944976

00:28:12.195 --> 00:28:14.127 deflect and that they are going to

NOTE Confidence: 0.919944976

00:28:14.127 --> 00:28:15.664 penetrate deep enough into your tissue

NOTE Confidence: 0.919944976

00:28:15.664 --> 00:28:17.440 and land in the exact right spot.

NOTE Confidence: 0.919944976

00:28:17.440 --> 00:28:18.440 But what this group?

NOTE Confidence: 0.919944976

00:28:18.440 --> 00:28:20.576 Did is they said well based on her
pre brachytherapy MRI we could design this custom ring cap that’s going to go over the existing ring and they drilled holes at pre specified distance and at angles to help guide the needles into the right place. So that going into the procedure of the breakey therapist was able to place these needles at the sort of predetermined spots and better shape the needles and guide them to the tumor. So, you know, I think that there’s now been a couple more of these types of
published examples in the literature, and it seems like brachytherapy might be a perfect match for 3D printing, given the individualization needed for every application. We’re no longer in A1 size fits all era. This is another example of a 3D printed cylinder, similarly to guide needles. And I will say that when you’re in the OR in this very tight space and a very narrow vagina and you’re trying to properly deflect and guide needles at a specific angle, it can be very challenging to do so. Having an applicator which is
kind of doing that for you, it’s bending and also stabilizing the needle in the right spot makes a lot of sense. This is work from a colleague of mine at Stanford University who worked together with her physicist and engineers at Stanford that they came up with these templates and they basically said rather than 3D customized printing on a per patient basis, rather they developed a repertoire of templates to have in their department to use for all of their cervical cancer cases. So basically they designed a couple of 3D printed templates and they choose.
one of these prior to a procedure.

The hitch is on to the tandem.

So they’ll place a tandem and their ovoids, and then through one of these templates, guide the needles.

It’s a place and they’ll figure out ahead of time which template would be best suited for a given patient.

They found this to be a low cost solution and cost about $5 to print this in house and $100 if they.

It removes some of the variability and randomness of the freehand approach and it helps standardize the procedure more, and that way it can make it more
NOTE Confidence: 0.880266404333333
00:30:23.326 --> 00:30:24.602 accessible to trainees or other
NOTE Confidence: 0.880266404333333
00:30:24.602 --> 00:30:26.240 practitioners who are looking to get
NOTE Confidence: 0.880266404333333
00:30:26.240 --> 00:30:28.056 started with a hybrid application process.
NOTE Confidence: 0.7801148225
00:30:30.130 --> 00:30:32.098 This was a 3D printed applicator
NOTE Confidence: 0.7801148225
00:30:32.098 --> 00:30:34.710 from two of our own brachytherapy,
NOTE Confidence: 0.7801148225
00:30:34.710 --> 00:30:35.925 physicist Doctor Christian
NOTE Confidence: 0.7801148225
00:30:35.925 --> 00:30:37.545 and Doctor Jay Chen.
NOTE Confidence: 0.7801148225
00:30:37.550 --> 00:30:39.615 So this was printed for a patient
NOTE Confidence: 0.7801148225
00:30:39.615 --> 00:30:42.449 who had a very narrow vaginal anatomy
NOTE Confidence: 0.7801148225
00:30:42.449 --> 00:30:45.065 that wouldn’t fit one of our standard
NOTE Confidence: 0.7801148225
00:30:45.065 --> 00:30:46.405 applicators and required needles.
NOTE Confidence: 0.7801148225
00:30:46.410 --> 00:30:48.546 So 3D printing can be used to rapidly
NOTE Confidence: 0.7801148225
00:30:48.546 --> 00:30:50.385 manufacture and implement customized vaginal
NOTE Confidence: 0.7801148225
00:30:50.385 --> 00:30:52.465 applicators that could be sterilized,
NOTE Confidence: 0.7801148225
00:30:52.470 --> 00:30:54.095 made of biocompatible material and
NOTE Confidence: 0.7801148225
potentially result in high quality brachytherapy for patients whose anatomy is not ideally suited for commercially available applicators. And sometimes we need smaller ones or different shaped ones. This is a different 3D printed vaginal applicator that we're currently testing in a clinical trial here at Yale. It's not for cervical cancer, but for endometrial cancer where vaginal brachytherapy is typically done after hysterectomy. So just to Orient you, this is looking at a patient sideways, this is the bladder, this is the ******.
And a typical applicator is this straight vaginal applicator. And through that we aim to give her a dose of radiation to the vaginal apex. So with this trial is asking whether if we designed the applicator to look the same at the top where we’re giving the radiation, but to taper and narrow as it exits the patient through the lower portion of the vagina and the introitus if that would be more comfortable. For patients and more well tolerated. So I mentioned the applicator here because of the story which led to
its development as a clinician.

I had been walking around with this idea in the back of my head for several years.

And then one day, completely by chance, I received an e-mail from one of my colleagues who was working with the medical students who had a background in interest in 3D printing and engineering and he just needed a clinical application.

So the two of us met and we put our heads together and we designed and printed this one which I mentioned we’re currently testing in a trial.
I think we’re still very early on in this journey of 3D printing, but I do know that 3D printing is used in some of the other surgical fields and perhaps there are others here at the Cancer Center or the medical school who have similar programs and developments and would like to collaborate with us. As it stands now, I think potential applications of 3D printing for cervical cancer brachytherapy include manufacturing personalized guidance templates to optimize needle positions and
target dose distributions,
NOTE Confidence: 0.7801148225

also designing individualized
NOTE Confidence: 0.7801148225

applicators to fit patient anatomy.
NOTE Confidence: 0.7801148225

And I do see this as an area of future.
NOTE Confidence: 0.7801148225

Growth and promise.
NOTE Confidence: 0.873604502105263

So now I’m going to talk about
teach brachytherapy to our trainees.
NOTE Confidence: 0.873604502105263

So I mentioned in the beginning
of my talk that without breakey
therapy survival outcomes in
cervical cancer are not as good.
NOTE Confidence: 0.873604502105263

And yet the same research has shown
a disturbing high recent decline in
the utilization of brachytherapy.
NOTE Confidence: 0.873604502105263

specifically between 1998 and 2009,
It was estimated there was a decreased utilization rate of brachytherapy from 83% to 58%. And also data, the research has shown that patients are less likely to receive standard of care treatments at low volume centers. There has been a lot of thought and writing about this particular problem and the potential causes for underutilization of radiotherapy. It could be because of a lack of equipment, because of the intensive workflow. If you’re at a smaller practice, you’re treating all types of cancers.
Maybe you don’t have the time and resources for this type of cervical cancer program. There’s also patient access issues. Not everyone can travel for these treatments and. Something that’s also come out of numerous surveys is perhaps we aren’t properly training our residents, and there was a survey of recent trainees who felt that not seeing a lot of cases during their residency training was a very big barrier to learning breakey therapy. So perhaps people were coming out of training and not feeling comfortable or
confident that they could do breakey therapy.
So as a field, we’ve realized that we need to improve the way that we teach it, to make it more accessible and to change its perception from being an advanced, technically challenging technique to one that’s a component of routine practice. So it’s hard to teach breakey therapy in real time cases. The stakes are high, the patients under anesthesia, things are moving pretty quickly. So to supplement training, there’s been a growing interest in doing simulation based education,
which basically means using a pelvic mannequin in a setting outside of the OR where you can conduct workshops with residents and they can have the opportunity to place the applicators in a low risk setting. And this has been shown to help trainees remember the steps of the procedure and feel confident in doing the procedure. So that they’re more likely to do it when they go out in their own practice. And I’ve been, I’ve been able to participate in these workshops at an institutional level, also at national and international meetings, and this picture is taken from work that I
During my sabbatical and in Israel, I also mentioned earlier in my talk the movement towards more customized applications using needles into the residual cervical tumor. For a long time, the mannequins that were available to us were very kind of hard, durable plastic material that wasn’t very stretchy and didn’t really permit needle placements. But in 2021, a new prototype Phantom was released. This model was made of colloidal material that...
00:35:37.024 --> 00:35:39.328 was stretchy, it had a vagina,
NOTE Confidence: 0.817171624166667
00:35:39.328 --> 00:35:41.196 cervix, uterus, *****, and bladder,
NOTE Confidence: 0.817171624166667
00:35:41.196 --> 00:35:43.440 and it also permitted our applicators
NOTE Confidence: 0.817171624166667
00:35:43.503 --> 00:35:44.825 as well as needle. Placements.
NOTE Confidence: 0.817171624166667
00:35:44.825 --> 00:35:46.535 So we designed an inaugural workshop
NOTE Confidence: 0.817171624166667
00:35:46.535 --> 00:35:48.690 here at Yale to validate the model
NOTE Confidence: 0.817171624166667
00:35:48.690 --> 00:35:50.250 for teaching hybrid needle placements.
NOTE Confidence: 0.817171624166667
00:35:50.250 --> 00:35:52.050 We presented this work at ABS,
NOTE Confidence: 0.817171624166667
00:35:52.050 --> 00:35:53.686 the American Brachytherapy Society,
NOTE Confidence: 0.817171624166667
00:35:53.686 --> 00:35:56.660 last year and recently published our results.
NOTE Confidence: 0.817171624166667
00:35:56.660 --> 00:35:58.172 This was from the 14 residents
NOTE Confidence: 0.817171624166667
00:35:58.172 --> 00:35:59.846 in our program who were surveyed
NOTE Confidence: 0.817171624166667
00:35:59.846 --> 00:36:01.670 and this was their responses to
NOTE Confidence: 0.817171624166667
00:36:01.670 --> 00:36:03.259 questions pre and post workshop.
NOTE Confidence: 0.817171624166667
00:36:03.260 --> 00:36:04.870 We asked them questions about
NOTE Confidence: 0.817171624166667
00:36:04.870 --> 00:36:06.002 their knowledge, preparedness,
00:36:06.002 --> 00:36:07.930 confidence in performing hybrid brachytherapy procedures.

00:36:08.900 --> 00:36:10.286 Red meant that they were not at all confident,

00:36:10.980 --> 00:36:12.499 blue meant that they were very confident.

00:36:12.500 --> 00:36:14.372 So you can see the shift in responses from pre workshop to post workshop.

00:36:16.220 --> 00:36:18.460 Obviously we know you can’t do this workshop one time and expect everyone to be experts,

00:36:18.460 --> 00:36:20.880 but there are lots of.

00:36:24.810 --> 00:36:26.334 Uh, there’s lots of programs and development at a national level.

00:36:26.334 --> 00:36:27.753 to improve brachytherapy training,

00:36:27.753 --> 00:36:29.157 but at least at an institutional level,

00:36:30.860 --> 00:36:32.816 we hope to continue conducting similar
hands-on workshops yearly in our program.

So in the last few minutes I’m going to shift gears and talk about quality of life and survivorship and cervical cancer. This is another area at Yale that we have a lot of support with help from our behavioral health and gynecologic colleagues, to make sure that our patients are on board with this information.

As I think I’ve shown, breakey therapy is a very personal treatment, and while going through it can be intense and emotional, for some women it could even be traumatic that we do our best to offer compassion and support every step of the way.
Post treatment, even if the cancer is cured and the patient wants to forget about it, put it behind them. The problem is that there can be significant long-term sequelae which take time to develop. These can be sexual or other effects that can negatively and permanently impact the lives of our patients if they’re not properly addressed. But many of these issues can be addressed, treated or even prevented. So we have to follow our patients very closely.
So in my opinion, post treatment care of women who’ve been through breaking therapy is a critical aspect of caring for the whole patient because we don’t want to save one part of their lives and then accidentally ruin another part.

So this is just an example of what happens to vaginal tissue after radiation. Now we all know that whatever your treatment modality is, whether it’s surgery, chemotherapy or radiation, the name of the game is to minimize side effects.

So here’s what happens after radiation. This is a biopsy from a healthy, normal vagina.
This is looking in the basil layer and you can see this is elastin, which is imaged with autofluorescence and it looks nice and linear. This is biopsy. From the vagina of a cervical cancer patient three to five years after radiation. So again it takes time, but what you can see is proliferation and elastosis and this can lead to progressive thickening and stiffening of the vagina. This can take months to years develop after radiation and its effects can be permanent, results in difficulty with.
exam or pain with intercourse.

So vaginal morbidity to some extent, whether it’s mucosal adhesions or bleeding after radiation is pretty common. And you know, even if it’s mild that can have a significant impact. Studies have shown that one to four, one to five cervical cancer patients have vaginal issues causing dyspareunia, and a significant proportion of these women stay sexually active despite pain to maintain their partner satisfaction and avoid marital problems.
So this is a pretty complex problem. Physical symptoms can lead to all of these issues here, whether it’s distress, fear of pain, cancer, loss of femininity, decreased body image, difficulty with partner.

A very simplified example of this would be a young cervical cancer patient is treated with radiation. She has pelvic issues that result in problems with dyspareunia. She doesn’t bring it up with her doctors. She remains sexually active.
albeit with tremendous pain and suffering.

She has relationship issues that result.

Her partner leaves her,

she has low self esteem and she

thinks something’s wrong with her.

I’m not saying that we as radiation oncologists can help with all

of those issues,

but we could do a lot simply by

raising and normalizing sexual concerns with our patients,

asking them about what they’re experiencing and making appropriate.

Girls when needed.

So one simple thing that we can do is really just ask our patients
So this is guidelines that were written by ASCO, so I'd encourage you all to take a look at this if you haven’t seen it was put out in 2018 looking at interventions to address sexual problems in people with cancer. The number one recommendation is that it’s the provider’s responsibility to initiate this conversation and to ask patients. About their symptoms. So how are we doing radiation oncology? This is a abstract that was presented at Astro in 2022 looking at
disparities in physician assessment
NOTE Confidence: 0.881755205714286

of sexual dysfunction in women
NOTE Confidence: 0.881755205714286

versus men receiving brachytherapy.
NOTE Confidence: 0.881755205714286

Men population was prostate cancer,
NOTE Confidence: 0.881755205714286

women population with cervical cancer.
NOTE Confidence: 0.881755205714286

Among the prostate cancer patients
NOTE Confidence: 0.79437202

90% had sexual function assessed.
NOTE Confidence: 0.79437202

Among cervical cancer patients about 10%.
NOTE Confidence: 0.79437202

So I think that unwittingly a lot
NOTE Confidence: 0.79437202

of providers are in addressing
NOTE Confidence: 0.79437202

sexual health with their patients,
NOTE Confidence: 0.79437202

especially with their female patients.
NOTE Confidence: 0.79437202

It’s probably not on the.
NOTE Confidence: 0.79437202

Providers, radar,
NOTE Confidence: 0.79437202

it’s not really part of our culture.
NOTE Confidence: 0.79437202

I remember seeing this first hand
as a resident understanding that patients are having these issues, but not really knowing how to address it, not being trained how to address it. So there’s a lot of barriers to discussion and you can see here there’s physician barriers, here there’s barriers on the patient side as well. And when you add these up, it’s very, you know, becomes very difficult to talk about these issues in the clinic. And I think it’s especially amplified in the female cancer population. But I think that one of the main
reasons why doctors might not ask is because they might not know how to address the problems they might uncover. But the tragedy of that really is that there’s a lot of very, very simple low tech tools that can really be available to everyone. So these are strategies to improve vaginal and sexual health and I would say they could be effective for probably about 80% of the types of symptoms that we see after radiation. So just some examples would be educating patients and giving them dilators to improve elasticity and prevent adhesions.
A lot of our patients have atrophy after radiating the pelvis, that hypo, estrogen and. Also fragility of the mucosa as a result of the radiation, the brachytherapy vaginal estrogen is very helpful, improving soreness and friction. Lots of education about lubricants and moisturizers or improving, you know, genito urinary symptoms of menopause or climacteric symptoms. A lot of our patients benefit from hormones. So in our practice,
we recommend a comprehensive approach

where the conversation starts before any treatments been given up front.

We counsel patients about potential vaginal and sexual morbidity,
quote incidence rates,
discussed mitigation strategies and normalize the concern.

During the radiation planning, we try to limit the vaginal dose as much as we can.

Now we have guidelines from the embrace and others as to how to do this effectively.

And then in terms of secondary prevention, a lot of the strategies that I showed you earlier recommending dilators,
lubricants, moisturizers, screening patients for sexual concerns.
Assessing vaginal and vulvar tissue quality, screening patients for menopausal symptoms, and referring our patients for further counseling and intervention, if warranted.

So I’ll mention here that education on this topic is an interest of mine, and I am a board member for an organization called the Scientific Network on female sexual health and cancer. It has a lot of links to valuable resources.
both for patients as well as for providers, so I’d encourage you all to take a look.

And back in November, I hosted here at Yale the 8th annual scientific meeting, which drew almost 100 researchers from around the country. We are very lucky at Yale to have The Sims Clinic. So we realize that physical symptoms aren’t the full picture and that sexual dysfunction can be a complex problem that has psychological, relational and cultural components.

And the symptoms caused by radiation can compound already existing
emotional and interpersonal issues.

So one of this resource is The Sims Clinic, which was developed by Doctor Ratner and Doctor Minkin and has representation from Julianne, oncology, gynecology with specialization and menopause, as well as psychiatry and psychology, and they do a comprehensive evaluation.

For our patients, we refer many of our patients there for their sexuality, menopausal and intimacy needs after brachytherapy. So I’m making a major plug
for this wonderful program.

And actually at the meeting that we hosted here in November, it was a pleasure to have a presentation from The Sims Clinic. I should mention that’s also run by Johanna Diario and it’s really one of the oldest programs in the world like this and has served as a model for many of the others to emulate. So with that, I’ll end.

We should be proud at Yale to have the resources that we need to treat our cervical cancer patients the best way that we can and to also help them live their lives the best.
way they can when treatment is done.

So thank you for your attention and I'd be happy to take any questions.

OK. Joe. So great, fantastic structure.

So the amount of personalization of therapy is.

Unlike any other site for the treatment.

And so I was just curious just to hear a little bit more about.

How you work with the community?

Because obviously we have all of these resources here,

we have you here, you know, and you’re instrumenting some of your patients,

get treated a little bit in the
Community and then come here. How do you negotiate that and how do you work with the outside referring Dr. to get that done? Yeah, I think that’s a great question. So, I don’t see myself as like a technician like philosophically I care for the whole patient. But I also want to say that the good news is there are breaky therapists in Connecticut. I’m not the only breaky therapist in Connecticut and they do a wonderful job. So many patients are treated outside
hospitals, but they also know these. Referring doctors know that for patients that need a lot of needles, if it’s a particularly big tumor or you know a vaginal that has a lot of vaginal involvement, they will send them up front to see me and I’ll partner with them because. So I don’t think I need to be treating all of the cases in Connecticut. But there are some cases that will really clearly benefit from needles and in general we don’t want to split care between teams. So I think you know if there’s one doctor
that can do the whole thing start to finish,
NOTE Confidence: 0.752160644545455
that's going to be better.
NOTE Confidence: 0.752160644545455
There will be less delays and you'll get
NOTE Confidence: 0.752160644545455
treatment time a lot quicker.
NOTE Confidence: 0.752160644545455
And Umm, you know,
NOTE Confidence: 0.752160644545455
so I think that when there's
NOTE Confidence: 0.752160644545455
really no other effective way,
NOTE Confidence: 0.752160644545455
I'm always happy to see the patient.
NOTE Confidence: 0.752160644545455
I meet them up front and this
NOTE Confidence: 0.752160644545455
is kind of our policy here.
NOTE Confidence: 0.752160644545455
We always review their pathology here.
NOTE Confidence: 0.752160644545455
We are part of the decision making up front.
NOTE Confidence: 0.752160644545455
We do our own baseline exam and you know,
NOTE Confidence: 0.752160644545455
because of resources and whatnot,
NOTE Confidence: 0.752160644545455
I have to set up the OR times in advance.
NOTE Confidence: 0.752160644545455
So I guess I see myself as a referral
for the most complicated cases, but not for all the cases. Does that answer your question?

Yes. Especially.

You mentioned about it, you just, you know, place much under the R, so you place the Middle Ages or transcript. Oh, that's a great question. So, right. So the question is about real time image guidance of needles. So you're right. There are several, not a lot, but there are some institutions that have an expertise doing transrectal
ultrasound and that is a very good modality to see where you’re placing your needles in real time. And others do MRI's kind of like how we’ve been doing it. I think there’s a, there’s also a, what do you call it, like a learning curve with the transrectal ultrasound. So I tried it a couple of times, but I found that sort of placing the needles and going to MRI. Is effective for me, but there are practices that do the transrectal ultrasound with excellent results.
Yeah, it’s a good question.
Yes.
Yeah, they can do it pretty quickly.
I don’t recall in that particular case, but I think it’s faster.
So I would like to grow our 3D printing program.
I think that’s really an area for future development and a lot of promise.
So, so like the like I mentioned at Stanford, they have an in House 3D printer within their own department.
So they can do that very rapidly.
I don’t think it takes too much time to do but we needed a couple of weeks.
00:48:10.840 --> 00:48:11.650 Just do it for sure.
NOTE Confidence: 0.9269076
00:48:15.070 --> 00:48:15.420 Yes.
NOTE Confidence: 0.6382878
00:48:17.980 --> 00:48:18.110 Yeah.
NOTE Confidence: 0.83442530375
00:48:35.410 --> 00:48:37.386 So I don’t see Chris in the audience.
NOTE Confidence: 0.83442530375
00:48:37.390 --> 00:48:39.442 I think he he’s done some
NOTE Confidence: 0.83442530375
00:48:39.442 --> 00:48:40.810 research into that question.
NOTE Confidence: 0.83442530375
00:48:40.810 --> 00:48:41.846 So the Mr. Lennox,
NOTE Confidence: 0.83442530375
00:48:41.846 --> 00:48:44.169 I think you can use to image your,
NOTE Confidence: 0.83442530375
00:48:44.170 --> 00:48:46.468 I think it is the right,
NOTE Confidence: 0.83442530375
00:48:46.470 --> 00:48:49.879 it is the right amount of magnetism
NOTE Confidence: 0.83442530375
00:48:49.879 --> 00:48:52.448 that you can image your implants well,
NOTE Confidence: 0.83442530375
00:48:52.448 --> 00:48:55.035 but I don’t and I know one of our
NOTE Confidence: 0.83442530375
00:48:55.035 --> 00:48:57.051 physicists has sort of looked into that
NOTE Confidence: 0.83442530375
00:48:57.117 --> 00:48:59.365 but because we don’t have an MRI linac,
NOTE Confidence: 0.83442530375
00:48:59.370 --> 00:49:01.128 so I haven’t examined that too
NOTE Confidence: 0.83442530375
00:49:01.128 --> 00:49:02.995 extensively but I I think that
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it would be compatible with the majority of the MRI. Safe applicators.

Yes, look, look. Move forward to new innovations and new therapies as you know proton therapy. Do you think that that’s another modality that you’ll be able to? Used to produce side effects. Are there? Other sites that are using. So it’s not not that common. I know that Doctor Lily Lynn at MD Anderson has the most experience using protons for gynecologic malignancies. But apart from that,
I don’t think it’s been used that often.

I don’t think it’ll replace brachytherapy, but in terms of whether it would be useful for pelvic radiation, there’s really not a lot of data about that at this point. I feel like when we start our program, we’re going to be focused more on some of the more CNS type of and pediatric type of cases, but maybe. With more research, we’ll see if that’s helpful. So to be determined. But probably for reradiation cases I can imagine that would be very helpful.