INTERVIEW: DR IAN FRASER

# CyberKnife and the Future of Cancer Treatment

**by Ava Janes**

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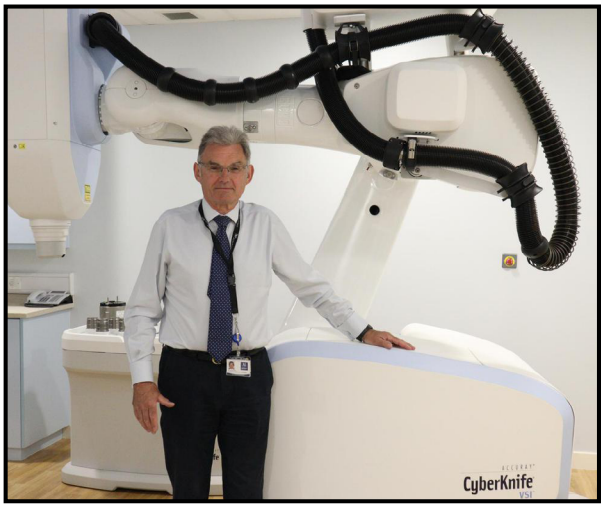
**Dr. Ian Fraser stands next to the CyberKnife robotic radiosurgery system**




*Cancer is a disease that has wedged itself into the mind of society as one of a cruel and devastating nature. As the second leading cause of death worldwide, it comes as no surprise that advances have been made in recent years towards developing potential therapeutic options.*

*However, the most pressing issue today is no longer just the killing of cancer. Instead, the focus lies in extending life while simultaneously avoiding any impairment to that life. As oncologist Dr. Siddhartha Mukherjee so eloquently wrote in this 2010 book, "The Emperor of all Maladies: A Biography of Cancer", what current therapy truly demands is the use of a "fantastically nimble knife: sharp enough to kill cancer yet selective enough to spare the patient". It is with this in mind that we can consider the possibility that perhaps this knife exists in CyberKnife.*

*I spoke to Dr Ian Fraser, Consultant Radiation Oncologist at the Hermitage Medical Clinic in Lucan, where he is a member of Ireland's first and only CyberKnife team, and asked him to offer an introduction to CyberKnife and what he thinks about the future of cancer therapy in Ireland.*

### First of all, what is CyberKnife and how is it different from other cancer treatments?

CyberKnife is a linear accelerator mounted on a robot that targets tumours with radiation beams. What makes it different is that it targets the radiation very accurately, to 0.2 of a millimetre. Because it's non-coplanar, you are bathing the tumour in a field of radiation which can be extraordinarily accurately delivered. This prevents damage to normal healthy tissue. For prostate cancer, it allows a margin of 2 to 5 millimetres, where normally you have a margin of about 1 centimetre with a half a centimetre at the back. For intracranial diseases, we use up to 200 beams specifically to protect normal structures, because while radiation therapy is about what you want to hit, it's also about what you want to miss.

### What cancers is CyberKnife licensed to treat and are there any risks associated with treatment?

Here in the Hermitage we focus on intracranial cancer. But it can also treat prostate and lung cancers due to its tracking ability which allows it to lock onto fiducials (gold seeds placed within the tumour) and so lock onto the tumour itself. This means that as the lungs or prostate move, CyberKnife tracks and targets only the tumour, unlike regular linear accelerators.

As for risks - there are always risks with radiation. Like in surgery, if you don't know where precisely the tumour is, you have the potential to miss. For example, if we have a prostate cancer where there is a breach of the capsule (outer layer of the prostate), we will not treat with CyberKnife because we use the capsule to define the borders of the targeted therapy. When the tumour has gone outside the capsule, we can't be certain where it is, and that's where your accuracy of 0.2 of a millimetre works against you.

CyberKnife is also expensive. The regular linear accelerator is going to cost you around €1.5–3 million. CyberKnife is €12 million. For the patient, it's around €20,000 for treatment, but is covered by health insurance. So it's a very expensive toy. But, if I was going to be treated for an intracranial, lung, or prostate disease, CyberKnife is what I'd want, because I think—and I've been in this field for a long time—I think that it's simply the best. It's the best I've ever seen.

### What can you tell me about the others involved in the CyberKnife team?

The team is a three-cornered stool. You've got physicians, physicists, and radiotherapists who are all highly-educated in their specialised field and work together to create a plan that is checked and re-checked before proceeding. Not infrequently we will have to amend this plan multiple times until everyone is satisfied. All of this is for safety. Safety is paramount and we are always learning from experience. During treatment, the procedure is checked 40 times a second to make sure everything is going to plan. If something deviates even slightly, the robot stops automatically and we figure out what happened, why it happened, and the consequences so that we learn from and don't repeat any errors. You have a great system when team members are all happy to learn from an experience in order to keep improving treatment delivery.

**Is there an experience that has particularly stood out to you from using CyberKnife?**

There was a patient whose lungs were wood-hard from smoking. He had non-small cell lung cancer, and the surgeons said that there was no way they could operate on his lungs because if they did, the procedure would kill him. So he was referred for CyberKnife. He actually developed a pneumothorax and ended up in ICU after the fiducial was inserted. So his lungs really were in dreadful shape—completely fibrotic with hardly any movement. He was using his neck muscles to breathe. We treated him with CyberKnife, and the cancer disappeared. When he came back two years later with a second cancer in his other lung, we treated that too. He's had extra years of life and is still ticking along. If we hadn't had CyberKnife, we couldn't have treated him.

When the patient described his experience in an interview with the Sunday Independent, he said how he was treated for only five days, that he was lying on the bed and he felt absolutely nothing. He is so tremendously happy with himself, and his wife is now an advocate for CyberKnife. It's a wonderful thing to see people—who otherwise wouldn't have had a chance—end up in a much better place.

**I can imagine then that CyberKnife would be a very popular option for patients. How satisfied are you with its accessibility, and who decides what patients get to avail of it?**

I feel that it is not as widely available as it should be and that it would be much better if we could treat more public patients and had more open referrals from other hospitals around Ireland.

Currently, it doesn't even have a waiting list. This is for many reasons, one of which is that there are protocols to determine patient suitability. This is figured out through an MDT meeting which is made up of the surgeon, radiation oncologist, diagnostic neuroradiologists, physicists, and radiation therapists. That's five different groups of people who discuss the case and must all give the 'okay' in order for the treatment to go ahead. We have defined treatment protocols. If these protocols are not met, the treatment does not go ahead. If someone at any point along the treatment process says they are not comfortable with how appropriate it is, we stop and have a long look at the plan to see if this really is the best option for the patient. And if it isn't, the treatment doesn't happen.

**Where do you envision us being in 10 years' time concerning cancer treatment and what is the future of CyberKnife here in Ireland?**

Oh, my god! Where am I even going to be in 10 years' time [laughs]? Well, when I started my career, the smallest tumour volume we could treat was 64 cubic centimetres. We're now down to 30 cubic millimetres. So, in 10 years' time, that'll be defined even better. The volume will be even smaller and therapy even more accurate.

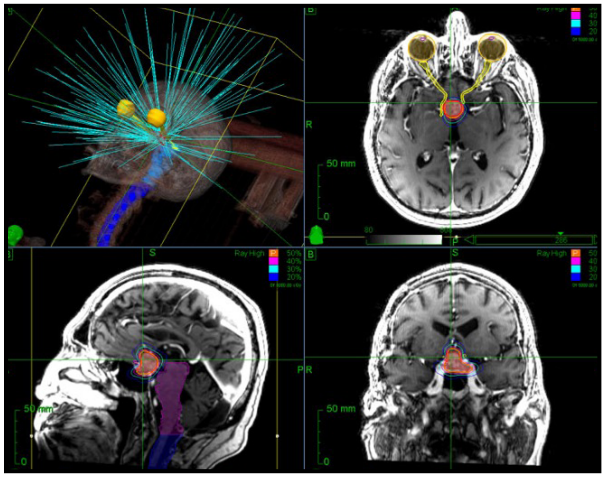
The other thing that's coming in is artificial intelligence, which is going to identify your normal healthy structures—where your lungs are, where your spinal cord and oesophagus are—and then define the tumour treatment area. You'll still need a doctor, physicists, and therapists, but AI is going to move this entire process forward. It's going to change everything. Here in the Hermitage, we are hoping to shortly have artificial intelligence which we can use in our radiotherapy department.

Concerning the future of CyberKnife, I think the aim will be to secure another in Ireland and establish a network between them. The future of treating intracranial, prostate, and non-small cell lung cancer is definitely with short, sharp treatment administered from outside the body using something like CyberKnife, because it is extremely simple and equally as effective as surgery.

**Is there anything in this field that you think we should be talking about which we aren't?**

Cancer is a multidisciplinary treatment area, so it's only going to flourish if everybody understands what the other members of the team have to offer. You've got to operate as a team. The purpose is to maximise the benefit for the patient. The timing of the different modalities may be the difference in outcome for the patient. It is so important that everyone respects the contribution of the others in the MDT. You see, teamwork is what medical care is all about. Teamwork is vital. A good team will always result in a better treatment than an exceptional individual ever will. Individualism is fantastic, but individualism has to be part of a team. And if you contribute to a team, that's far more satisfying for yourself and else everyone involved. ◂

**Targeting a pituitary adenoma with minimal dose to other critical structures such as the optic apparatus**




## Acknowledgements

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## Declarations

Ava Janes is a staff writer on the editorial board of the TSMJ, and was asked to contribute an article to Volume 22. The author declares that the article was written in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.