Optimising Radiotherapy

Improving outcome and reducing side-effects

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Nuclear Techniques in Human Health

Prevention, Diagnosis, Treatment

GROOTE SCHUUR HOSPITAL

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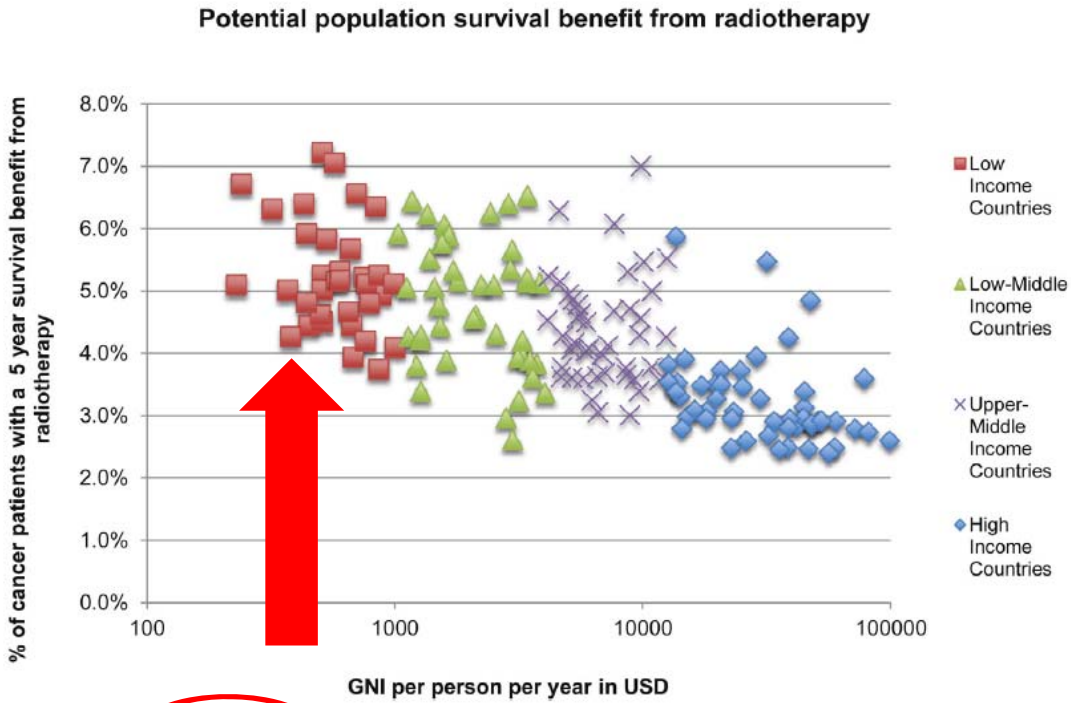

Fig 4. Survival benefit from radiotherapy according to country income classification.

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Overview

The Benefits of Providing External Beam Radiotherapy in Low- and Middle-income Countries

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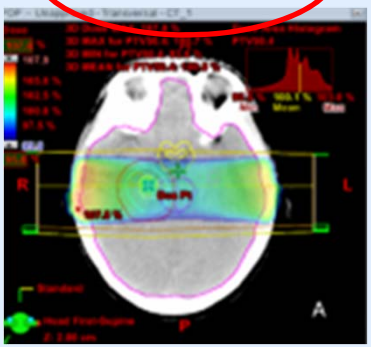
It is not only about getting there faster…

THE RADIATION BOOM

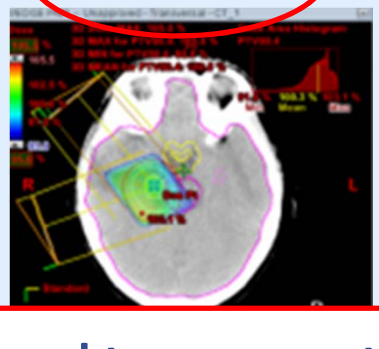
Radiation Offers New Cures, and Ways to Do Harm

By WALT BOGDANICH
Published: January 23, 2010

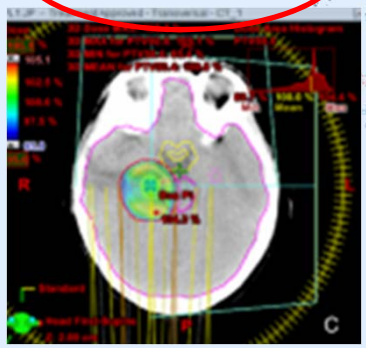
2D Planning



3D Planning



IMRT / VMAT



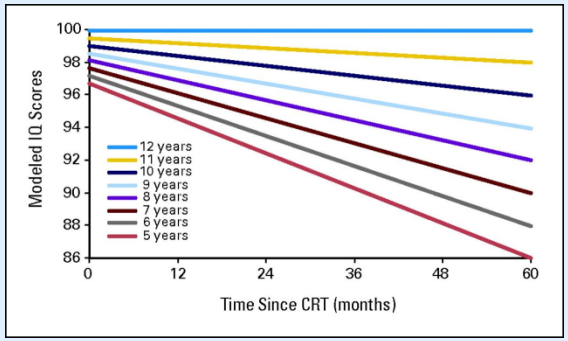
Improved tumour control

Increased risk !

It is also about getting there safely…

This what we want to avoid : severe late side-effects

Skin necrosis



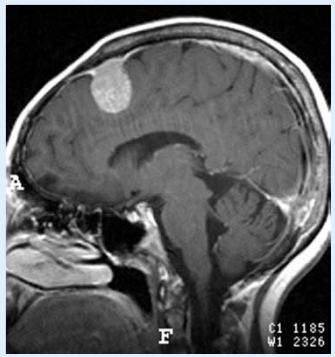
IQ decline after brain RT (children)

Osteoradionecrosis

Quality Assurance is key!

Growth deformities

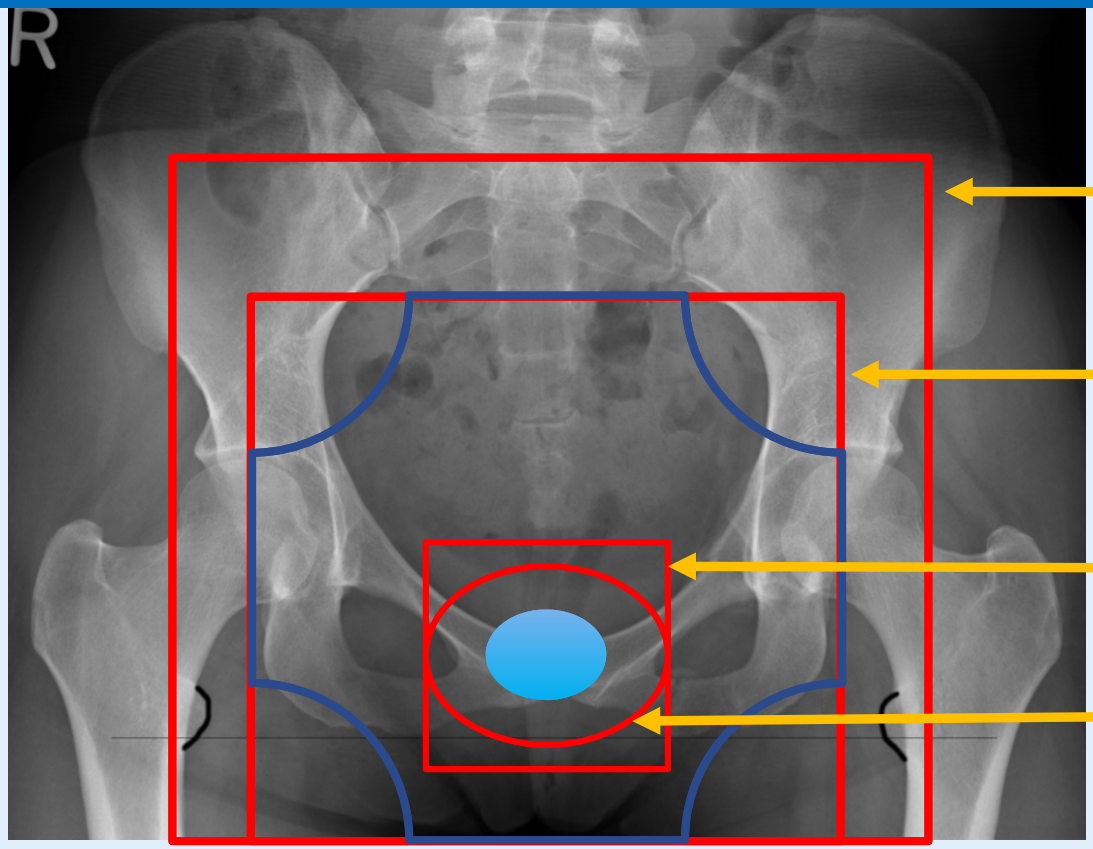
Radiation-induced malignancies



Cancer of the prostate

How treatment fields have evolved

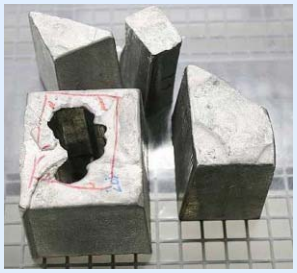
The aim of modern radiotherapy : to deliver an effective dose to the tumour – with as low a dose to normal tissue as possible

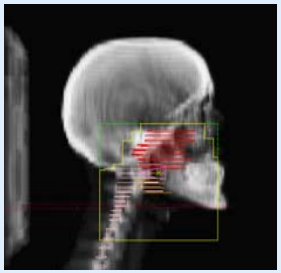


We need to *kill* cancer cells AND *protect* normal cells

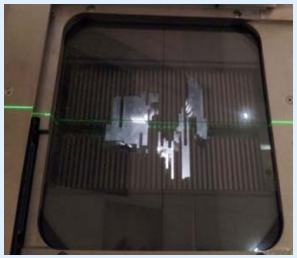
Lead cut-out

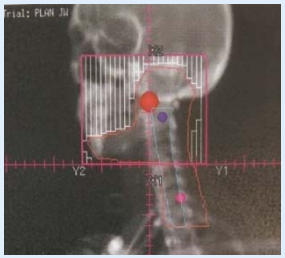
Lead blocks





Multi-leaf collimator





Shield normal tissue

A BALANCE BETWEEN

Tumour control

Complications

Thermoplastic cast

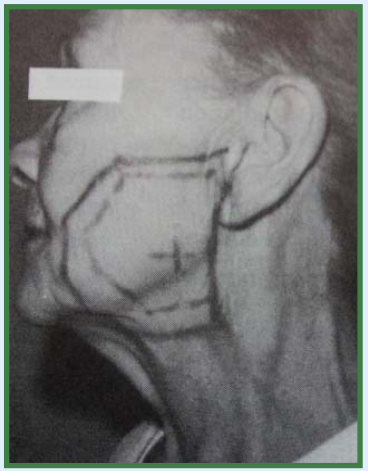
Breast board

Accurate and reproducible positioning

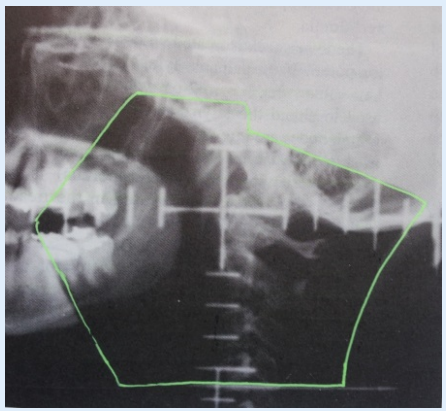
Knee and foot rests

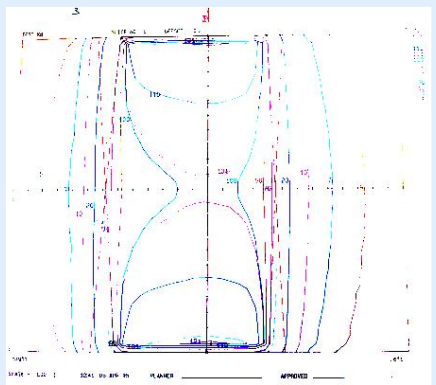
Computerised planning

2-Dimensional Planning



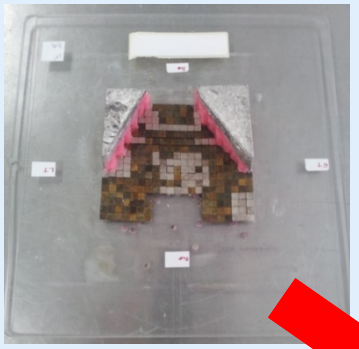
Field drawn in on Xrays





Hand-drawn 2 D plan

Radiation fields (shaped with lead blocks)



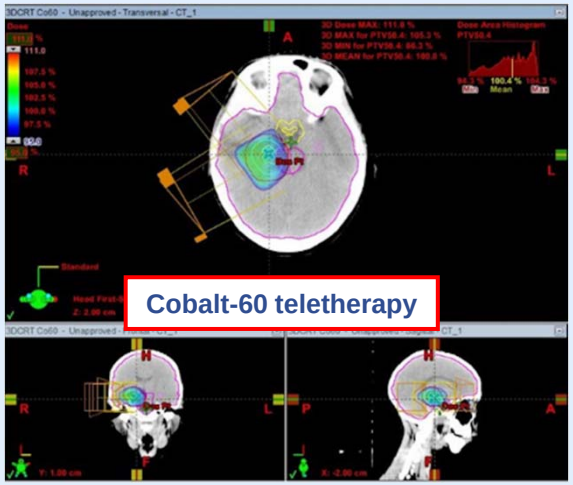
Cobalt-60 machine

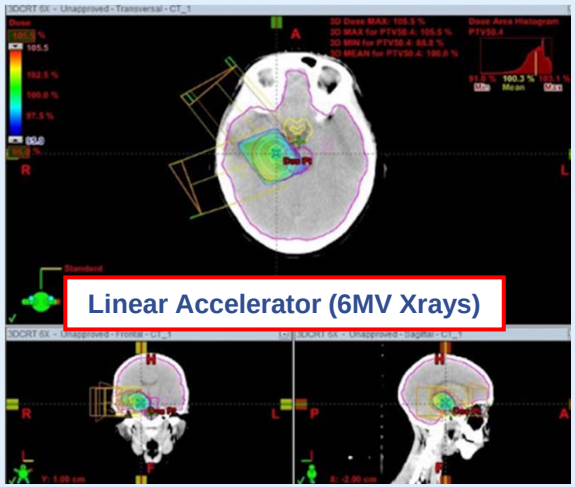
Until "recently" world-wide …
(Still used in many LMI countries)

3-Dimensional Conformal Radiotherapy

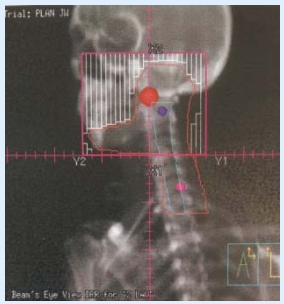
The aim of modern radiotherapy techniques :

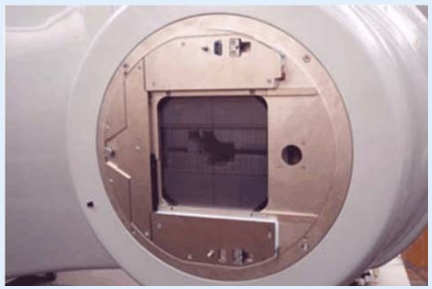
Highest possible dose to the tumour & *lowest* possible dose to normal tissue





Visualising the target area accurately is key…



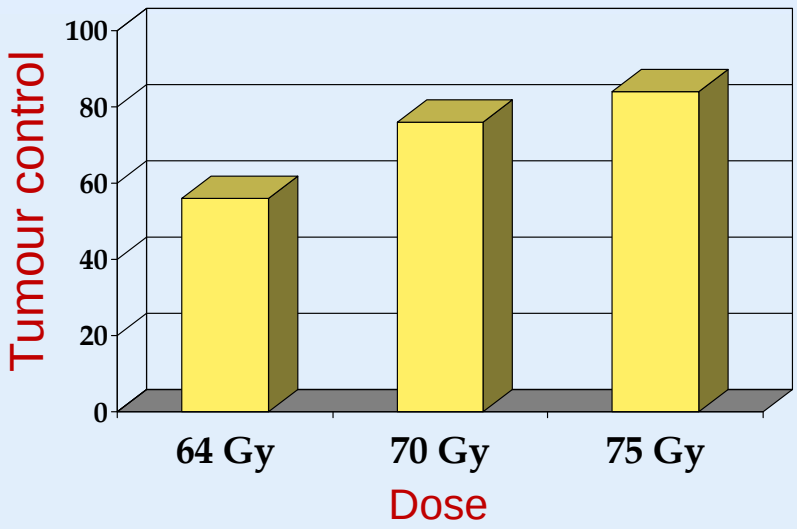


- **Sophisticated planning tools**
- **Reconstruction in all planes**
- **Multiple beams**
- **Different planes**
- **Beam shapers**
- **Highly skilled staff**

Cancer of the prostate

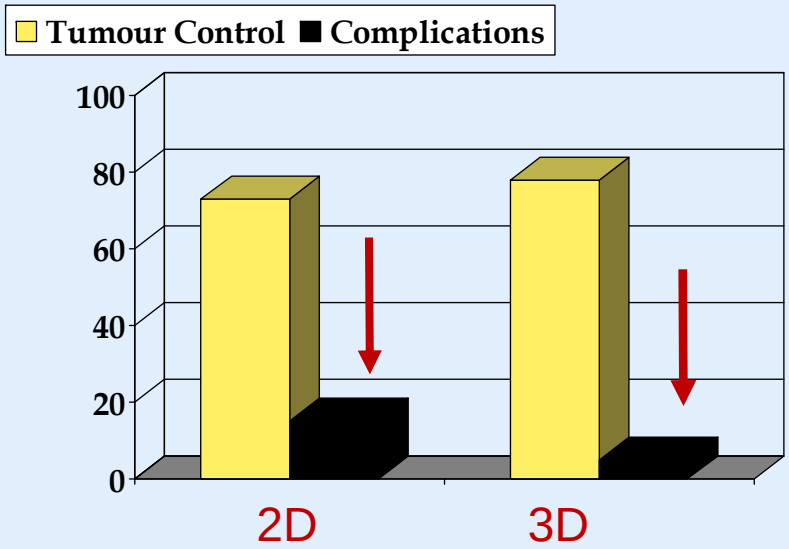
Outcomes of 2D vs 3D planning

Tumour control improves with increasing dose



Zelefsky, IJROBP 1999

Complications decrease with 3D radiotherapy



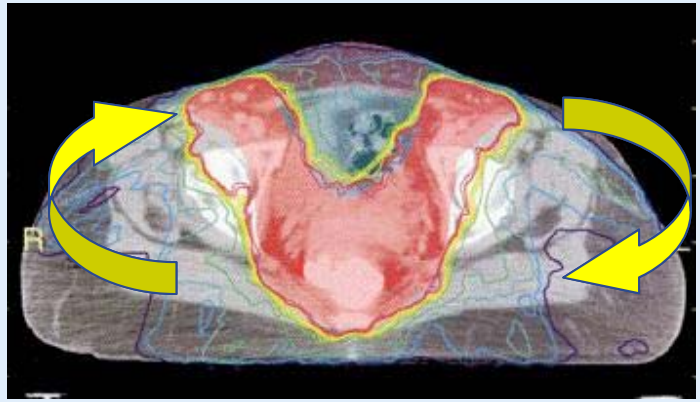
Dearneley et al, Lancet 1999

The Next Step …

Intensity Modulated RT & Arc Therapy (VMAT)

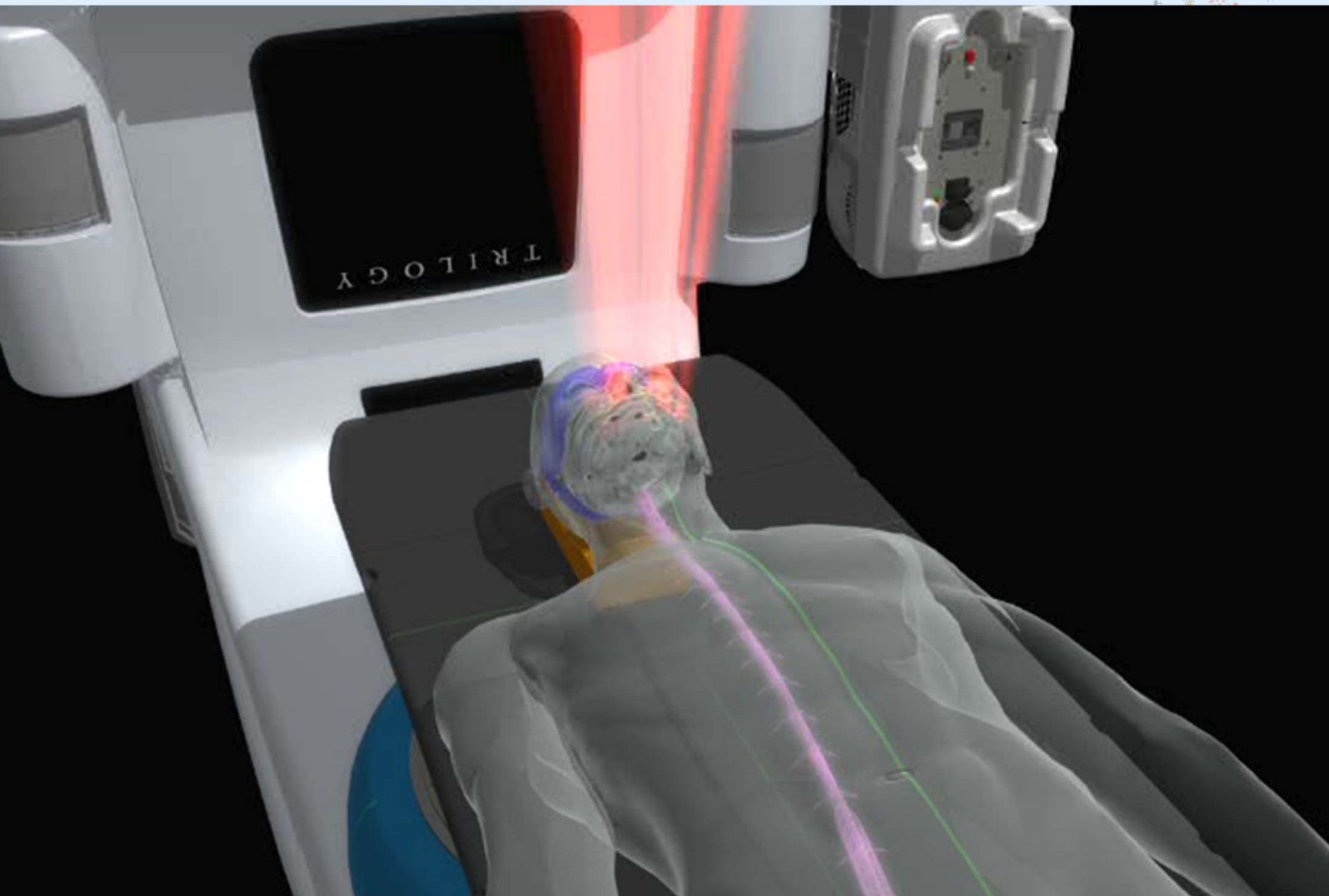
- Sophisticated computer software works out the beam arrangement
  - gives the optimal dose to the tumour
  - while keeping the dose to normal structures within tolerance
- The beam shaper now also filters (modulates) the beam
- The machine rotates around the patient during treatment – which can take as little as two minutes

Higher dose and tighter margins than previously possible

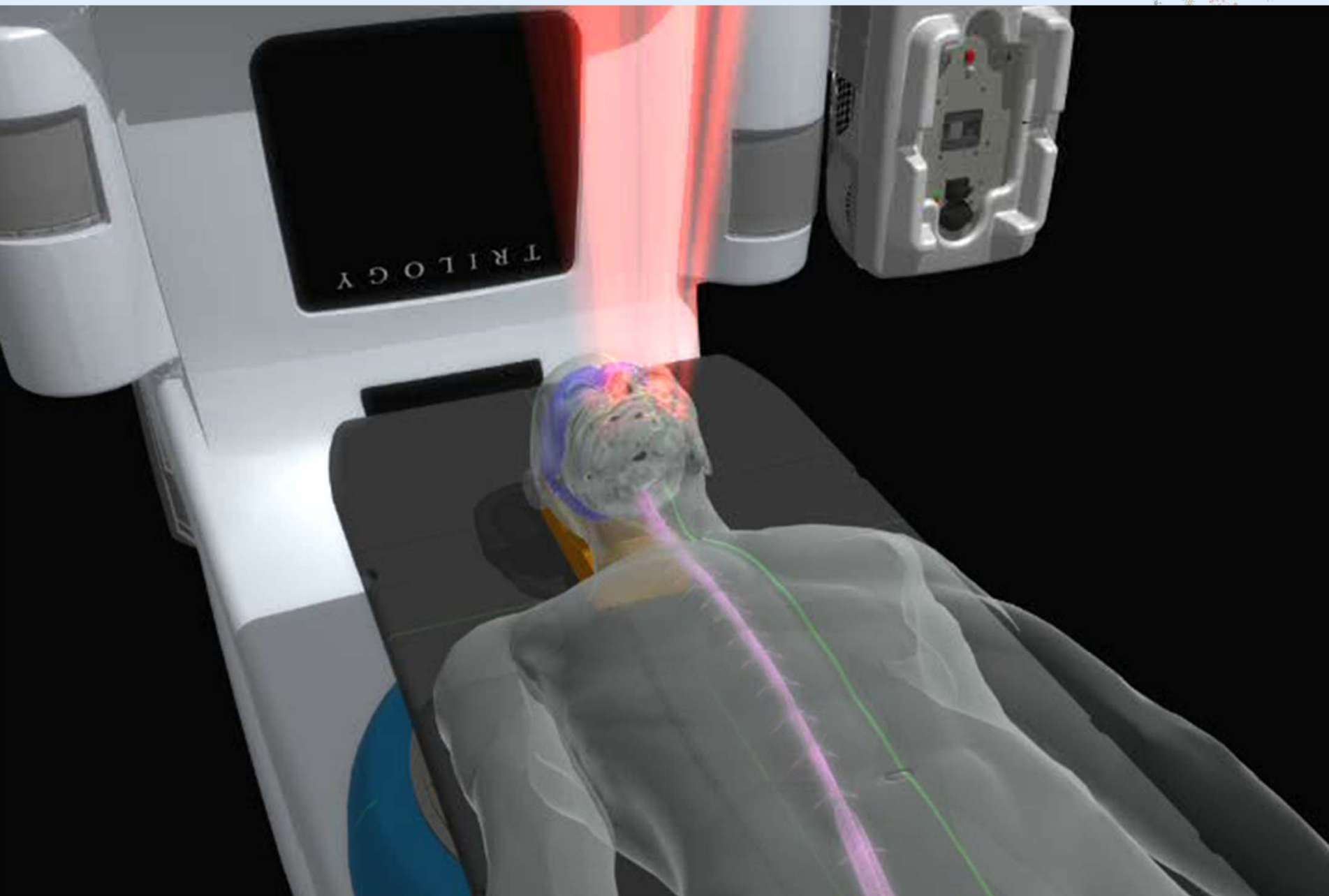


Shorter treatment time – therefore more patients treated per day

ARC Therapy (VMAT)

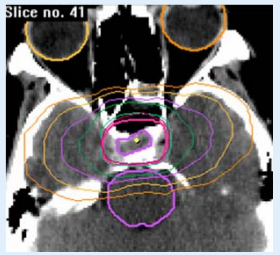


ARC Therapy (VMAT)



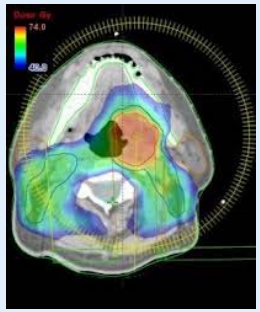
Modern Radiotherapy requires a TEAM of highly skilled people

RTT
CT scan



Doctor
Tumour delineation

RTT
Planning (computer)

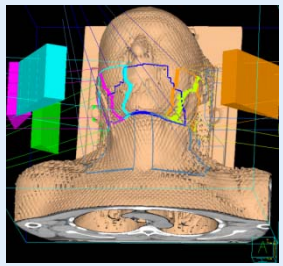


Patient

RTT
Treatment set-up / given

Physicist
Quality check

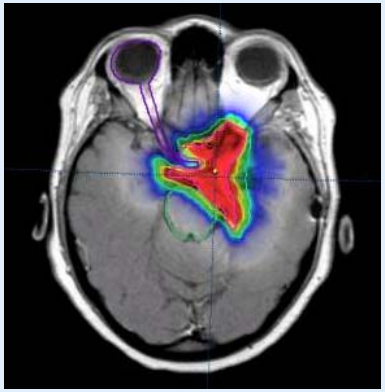
Doctor
Authorises plan



RTT & Physicist
Quality check <u>again</u>

A treatment plan is only as good as it's quality assurance

Stereotactic Radiosurgery



High dose of radiation

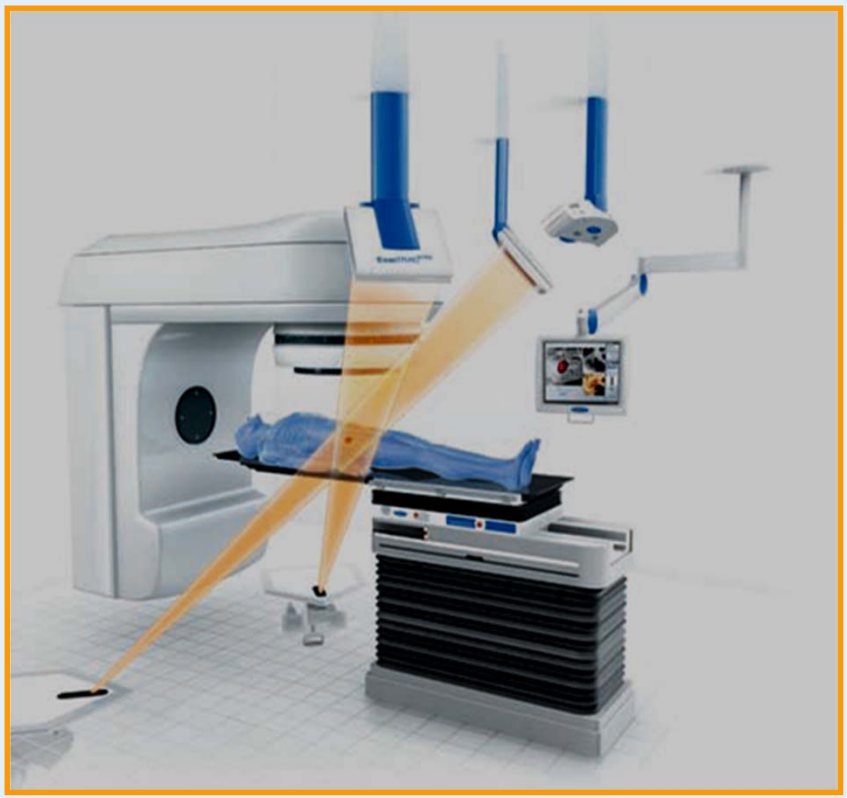
Single dose

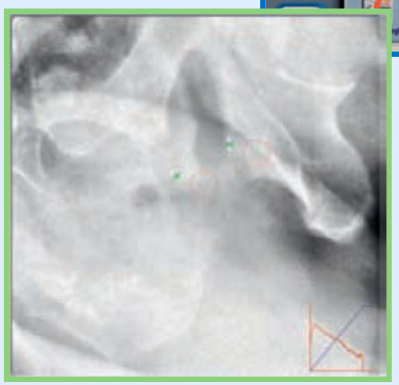
Small target

Brain & eye tumours

Stereotactic Body Radiotherapy

Single / multiple tumours



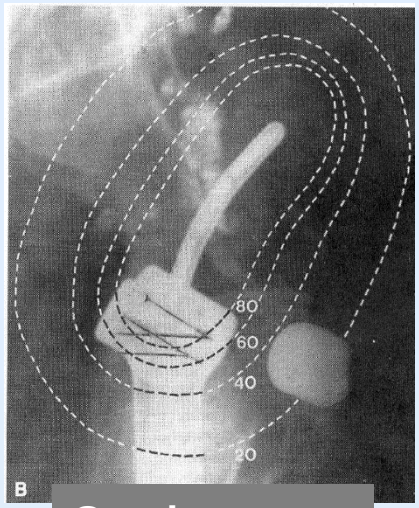


Infra-red cameras & Xrays localise points on skeleton

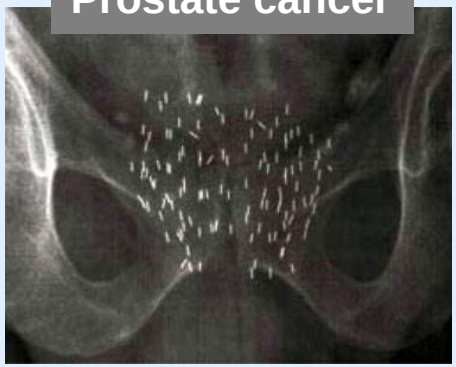
Computer ensures patient is accurately positioned for treatment

Brachytherapy

Sealed radioactive sources (radio-isotopes) placed adjacent to, or into, a tumour



Cervix cancer



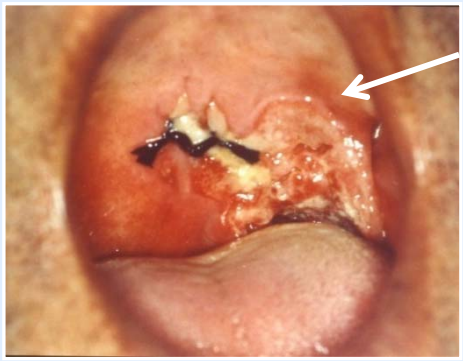
Prostate cancer

Skin cancer

Sarcoma

- Dose around the applicator (tumour) is ***high***
- Dose a short distance from the applicator (healthy organs) is ***low***
- Can combine with Xrays / surgery

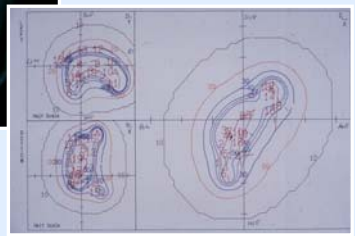
Remote after-loader

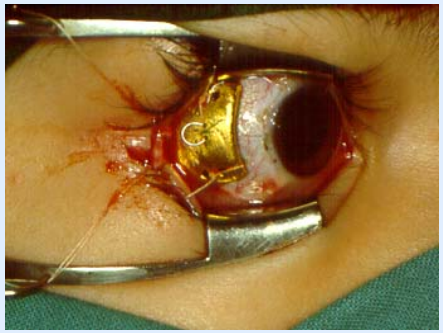


Tumour of the soft palate

Eye cancers

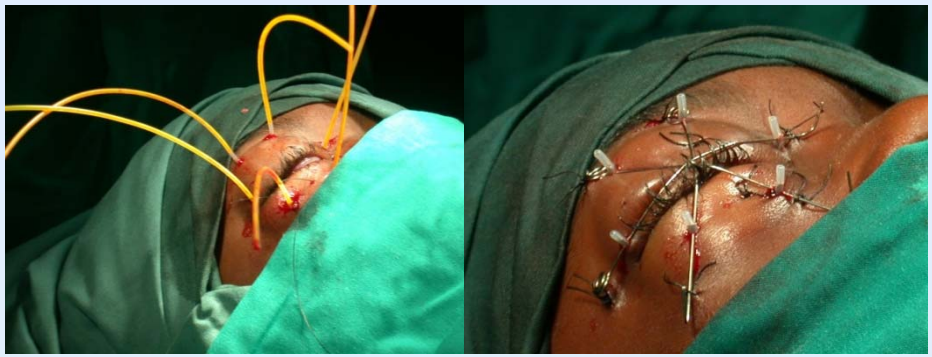
Head & neck cancers





Radioactive iodine eye plaque

2 years later



Radioactive iodine orbital implant

Also used to treat cancer of the oesophagus, bronchus

We have come a long way …