La terapia personalizzata in oncologia: stato dell'arte e prospettive nel settore della RADIOTERAPIA



V. DONATO

Azienda Ospedaliera San Camillo Forlanini

Camera dei Deputati, 25-26 ottobre 2011

1908



Nel 1908 il Dr. Chicolot dipingeva i primi trattamenti radioterapici con Raggi X

Medulloblastoma STORIA

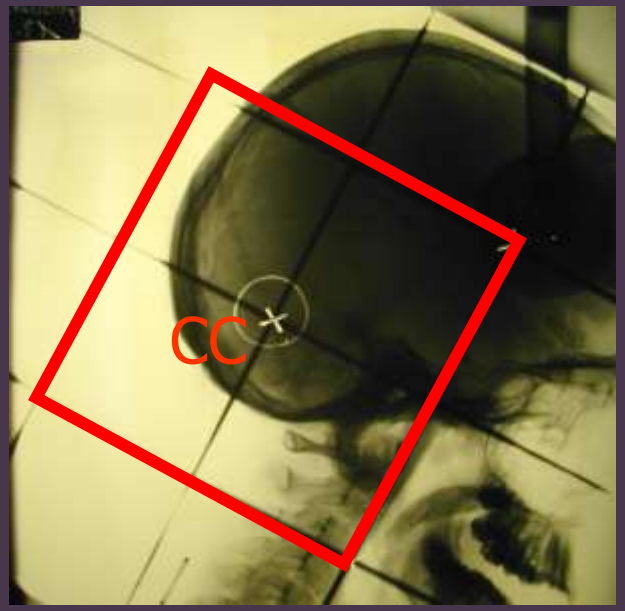
1950





Courtesy by Edward Helperin, Duke University

Definizione del “clinical target volume”



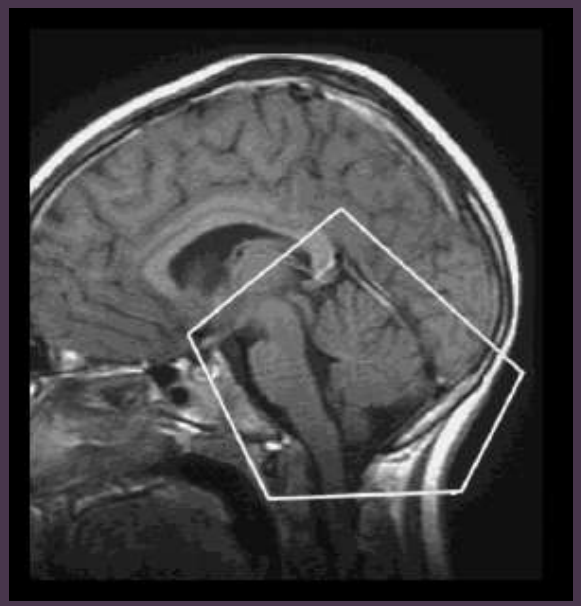


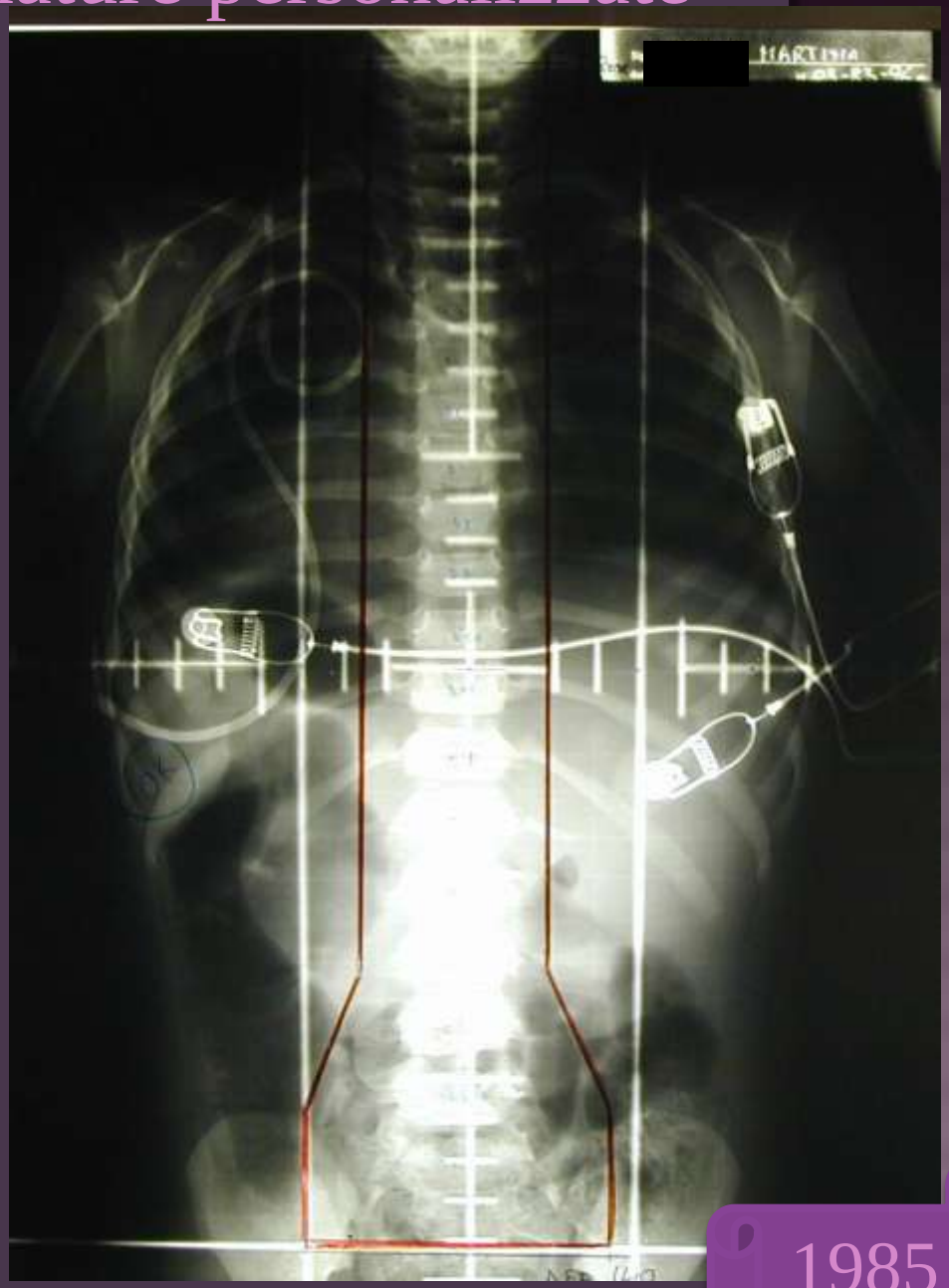


1980

Medulloblastoma: schermature personalizzate

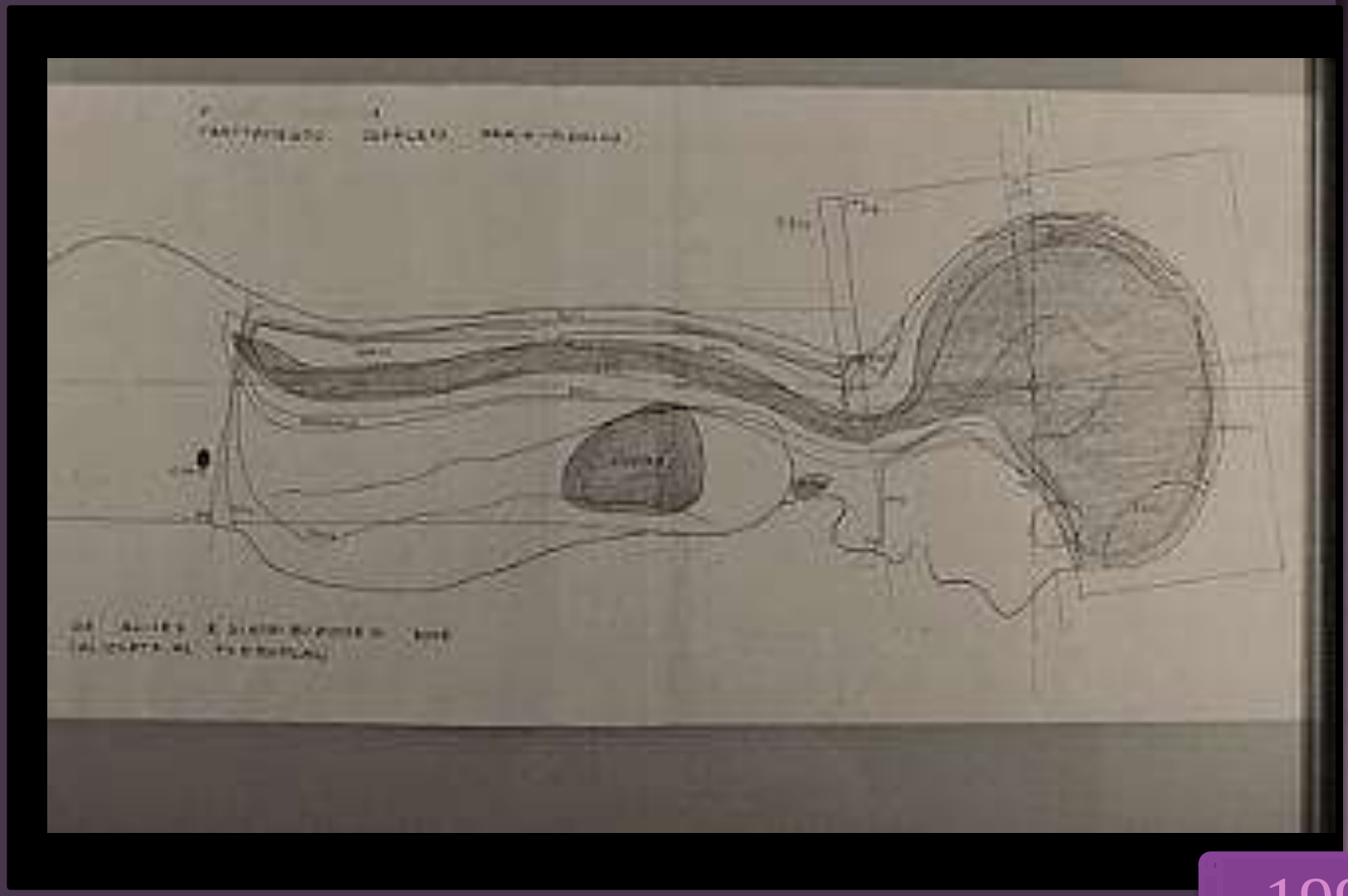






1985

Medulloblastoma: Pianificazione dal 2D al 3D



1990

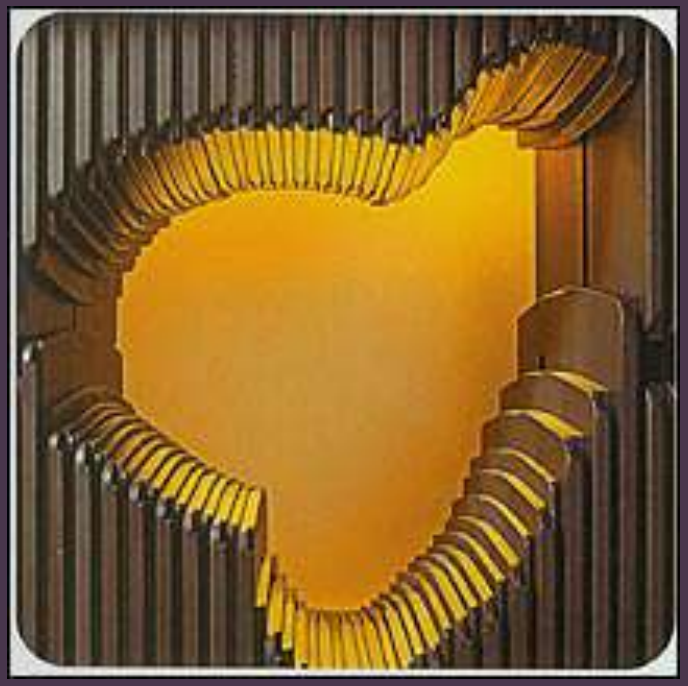
Medulloblastoma
supporti e sistemi di fissaggio personalizzati





1995

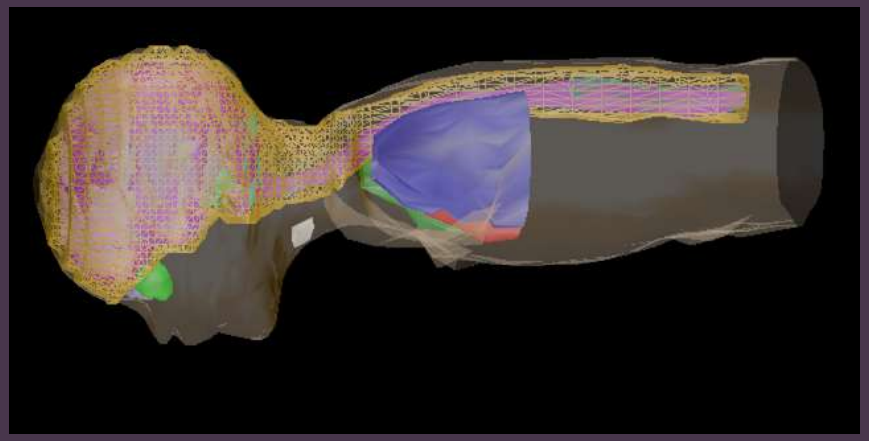
Medulloblastoma
Conformazione della dose “multileaf collimator” e verifica

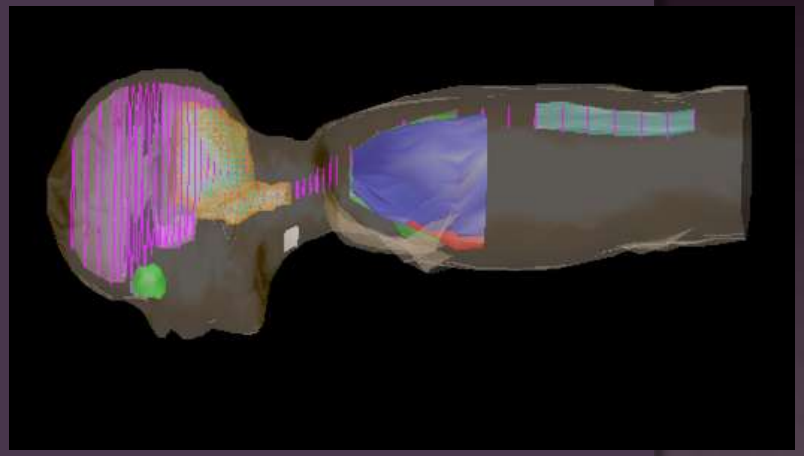


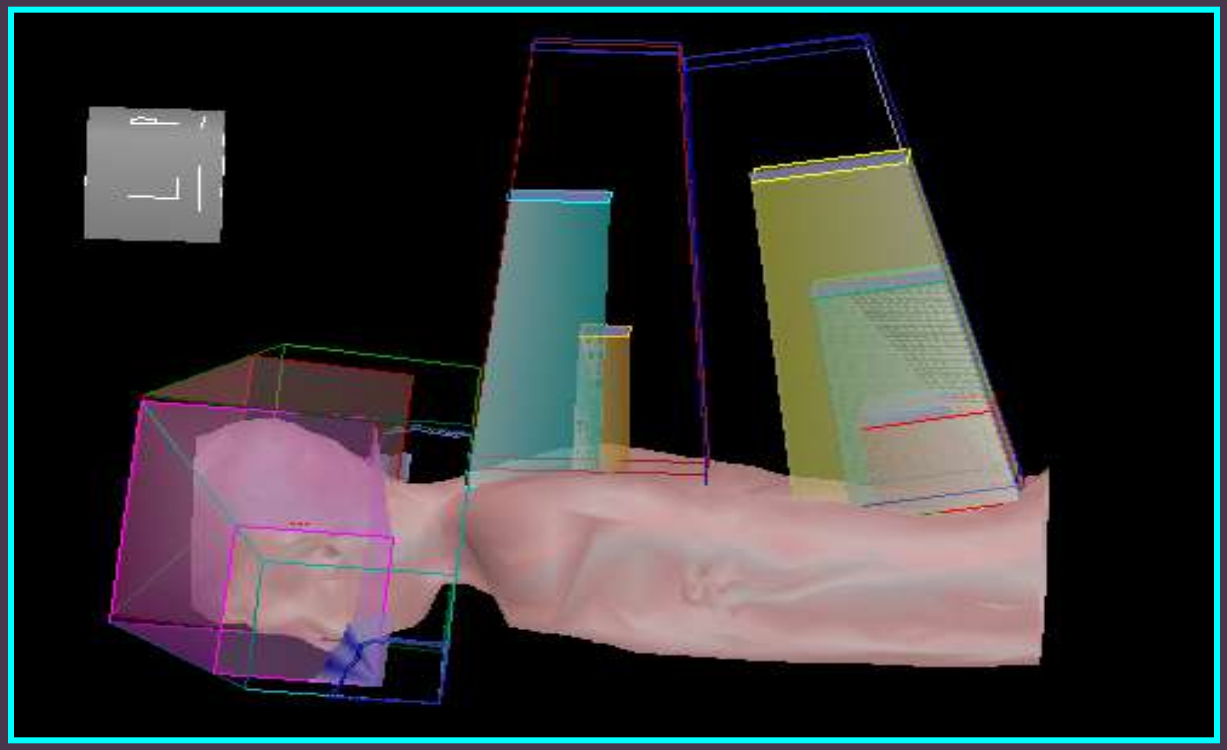


2000

Medulloblastoma: omogeneizzare la dose





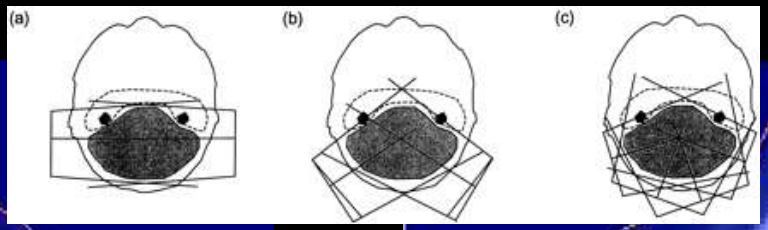


2000

Medulloblastoma: tecniche irradiazione > 2000

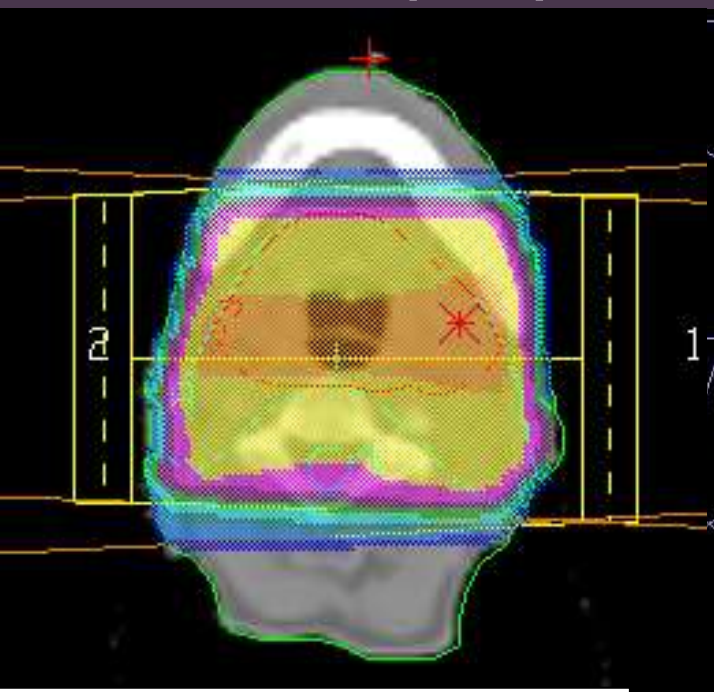
RT Standard - 2CC

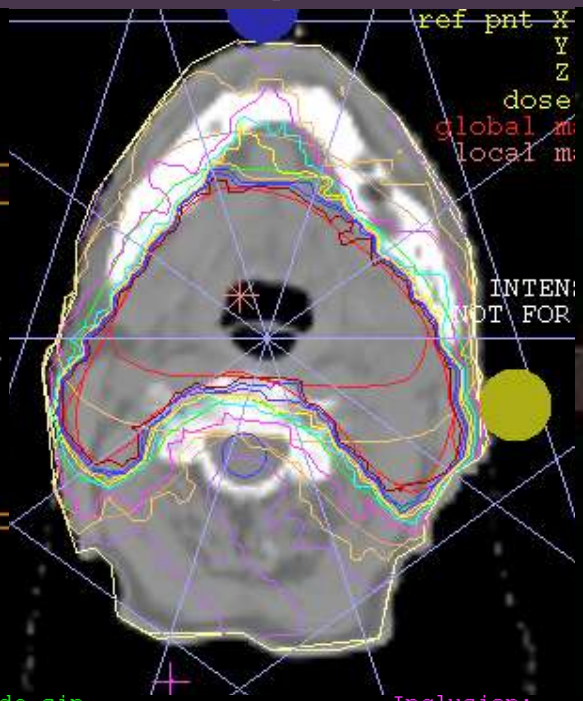
IMRT



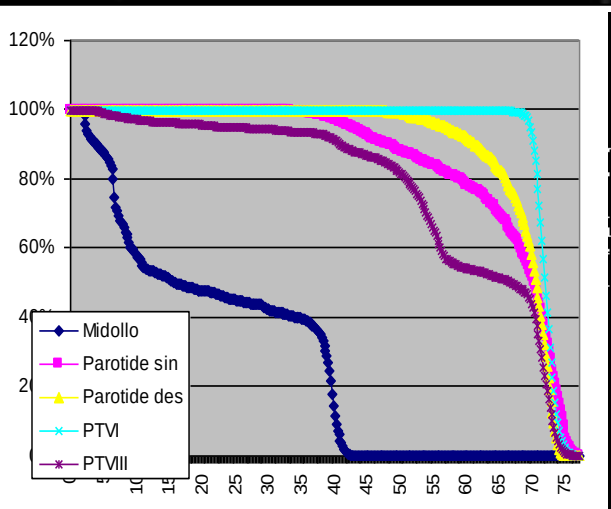
Calcolo del DVH e della distribuzione di dose

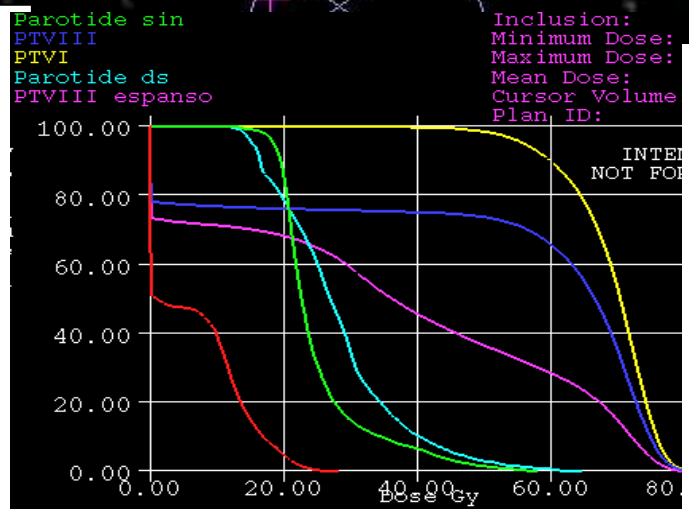
3D-CRT (1990) **IMRT (2000)** **Protons (2010)**

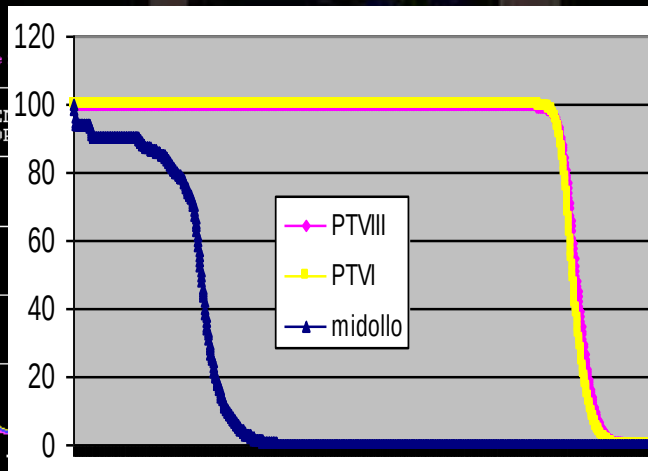






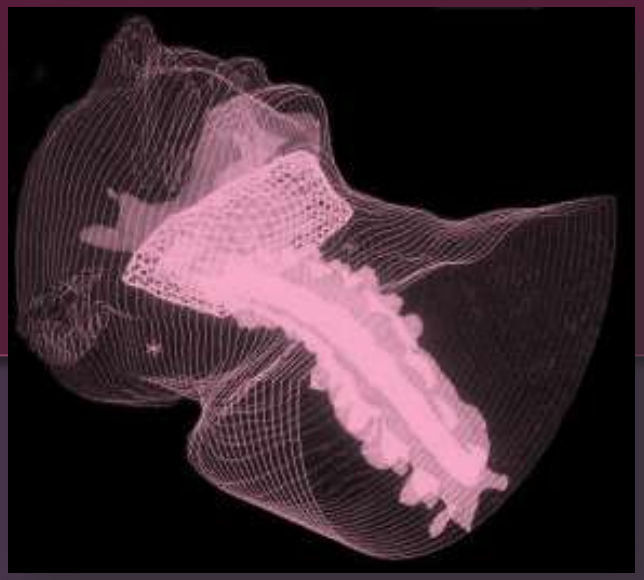






Evoluzione della tecnologia radioterapica

Miglioramento della precisione geometrica e dosimetrica del trattamento per aumentare la dose al volume bersaglio e diminuirla agli organi critici circostanti (target therapy)





IDENTIFICAZIONE DEL BERSAGLIO

Immagini di differente origine

Radiologiche > anatomiche > densità dei tessuti > secondo una proiezione

TAC > anatomiche > densità dei tessuti > secondo uno strato parallelo ad una sezione del corpo

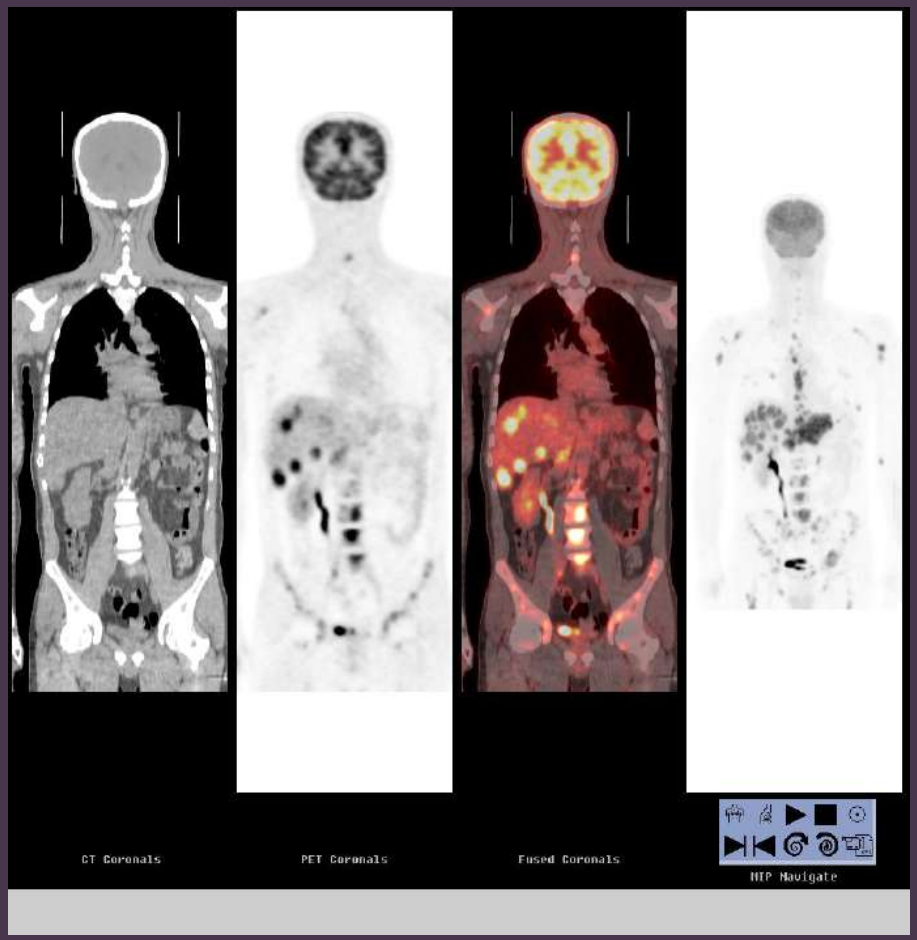
MRI > morfofunzionali

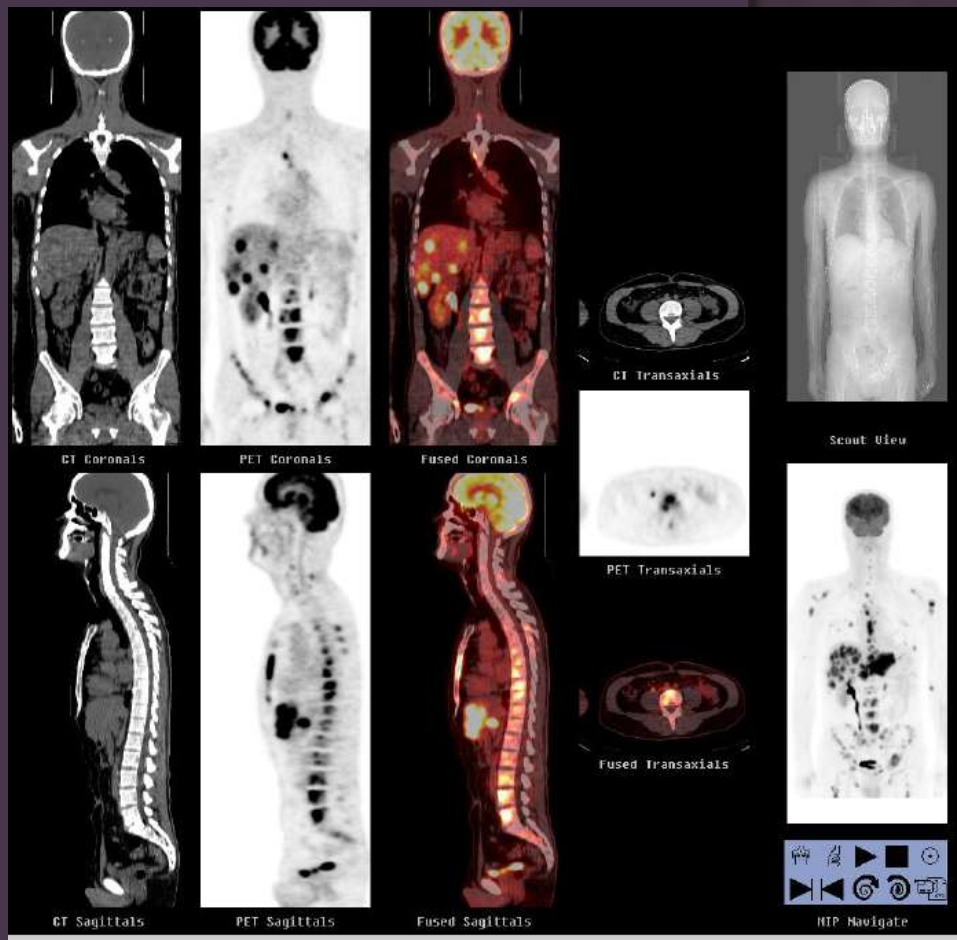
PET > morfofunzionali

CT-PET > anatomiche + morfofunzionali

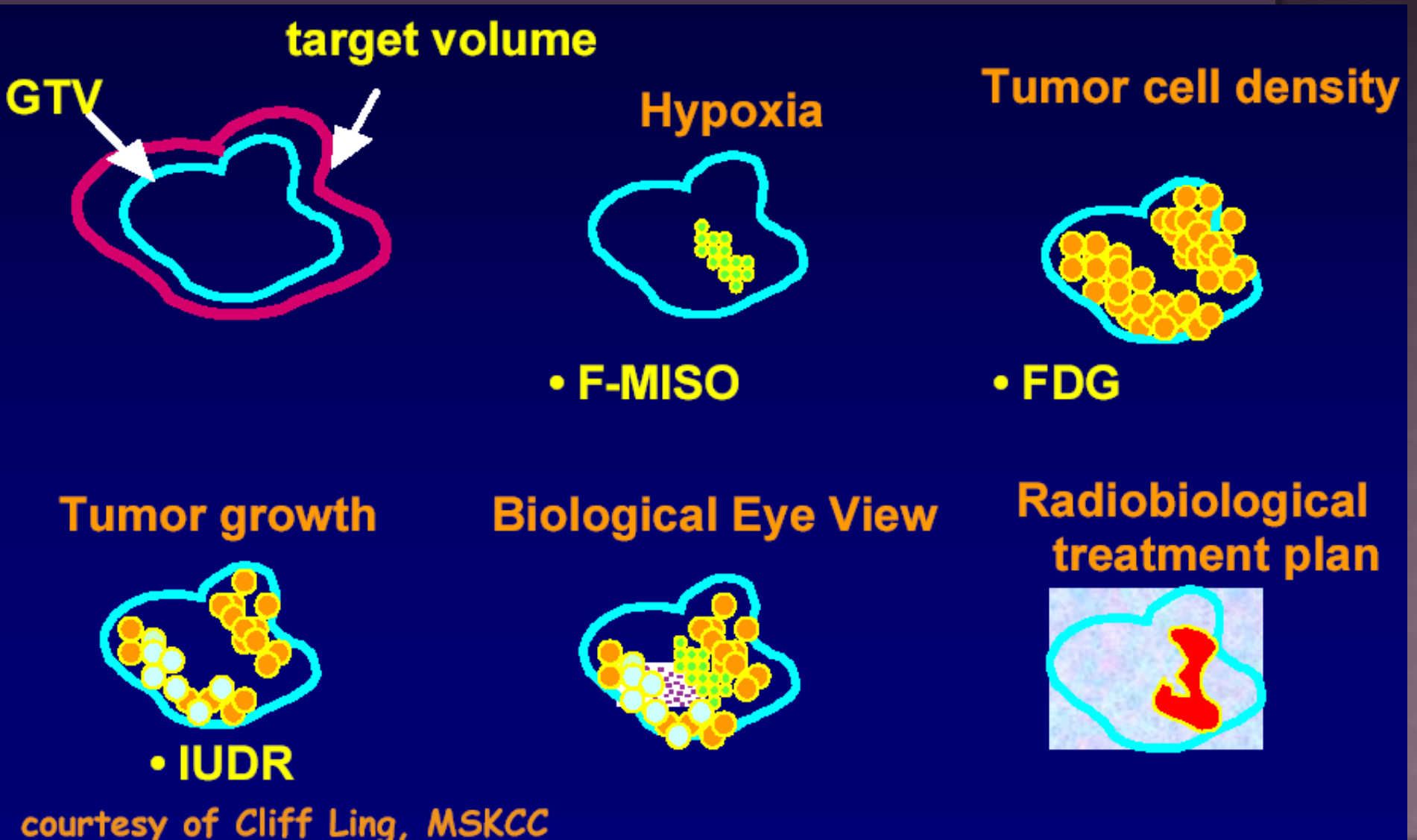
Molecolari

IMMAGINI PET/TAC





IMMAGINI MOLECOLARI: TARGET BIOLOGICI



TURN OVER TECNOLOGICO

2005>

Gli Acceleratori Lineari, per essere aggiornati devono essere completi di sistemi per l'acquisizione delle immagini durante il trattamento (IGRT) e di verifica in linea (Record and Verify).

Solo mediante questi sistemi è possibile effettuare in maniera efficiente una moderna radioterapia di elevata qualità e verificare in maniera personalizzata il grado di accuratezza della terapia.

2011- EVOLUZIONE TECNOLOGICA – ACCELERATORE CON IGRT









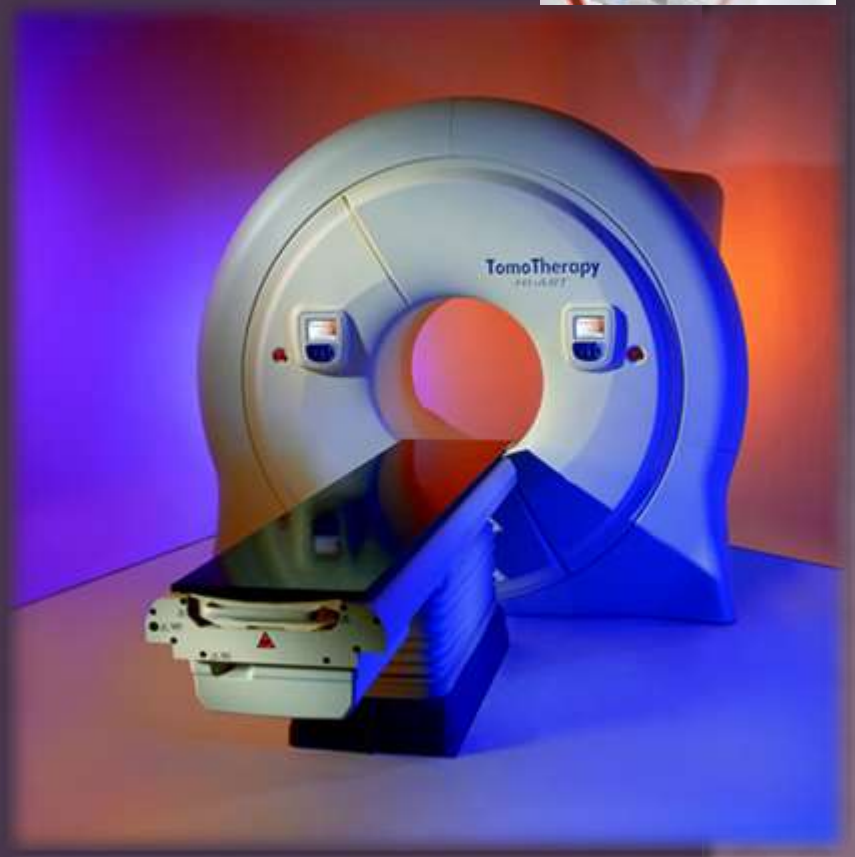

Future Directions:
“5th, 6th, 7th and more D” ?

SISTEMA D'IRRADIAZIONE DI NUOVA GENERAZIONE

Tomoterapia - MV CT- IGRT

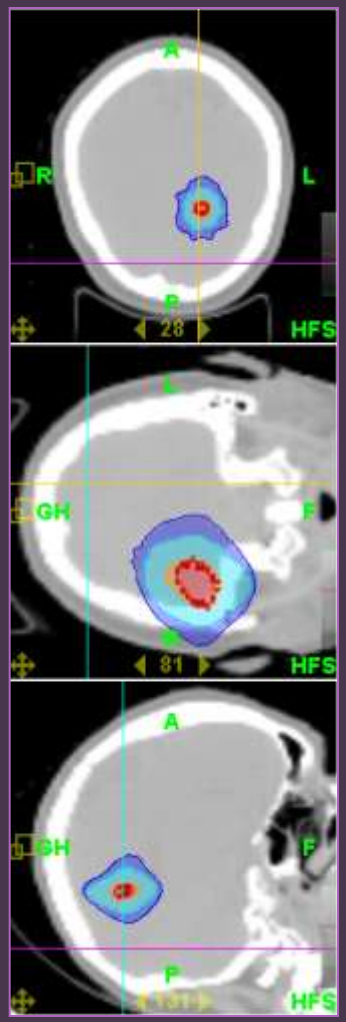
E’ un sistema che permette una corretta registrazione del paziente mediante il confronto diretto di immagini volumetriche ricavate da due TAC a spirale : la prima (cosiddetta di riferimento) ricavata dall’immagine TAC sulla quale è stato calcolata la distribuzione di dose; la seconda ricavata dalla TAC ad alto voltaggio incorporata nella macchina di Tomoterapia e ricostruita immediatamente prima del trattamento



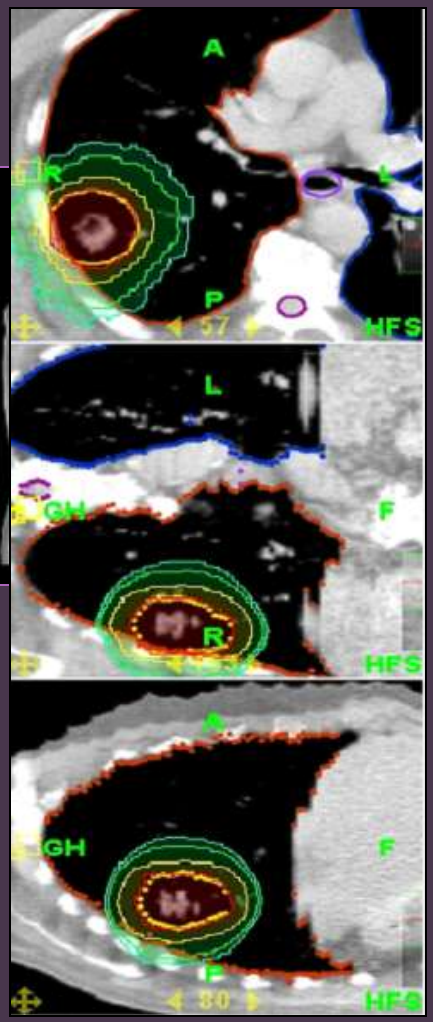


TOMOTERAPIA - ESEMPI DI TRATTAMENTI

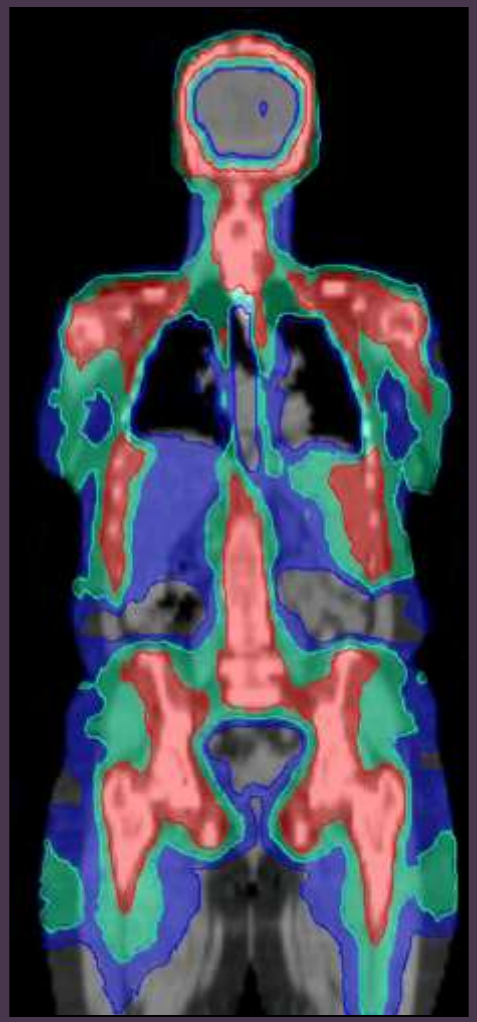
SRS/SRT



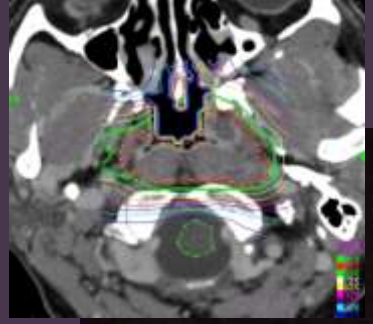
SBRT



TBI/TMI Craniospinale

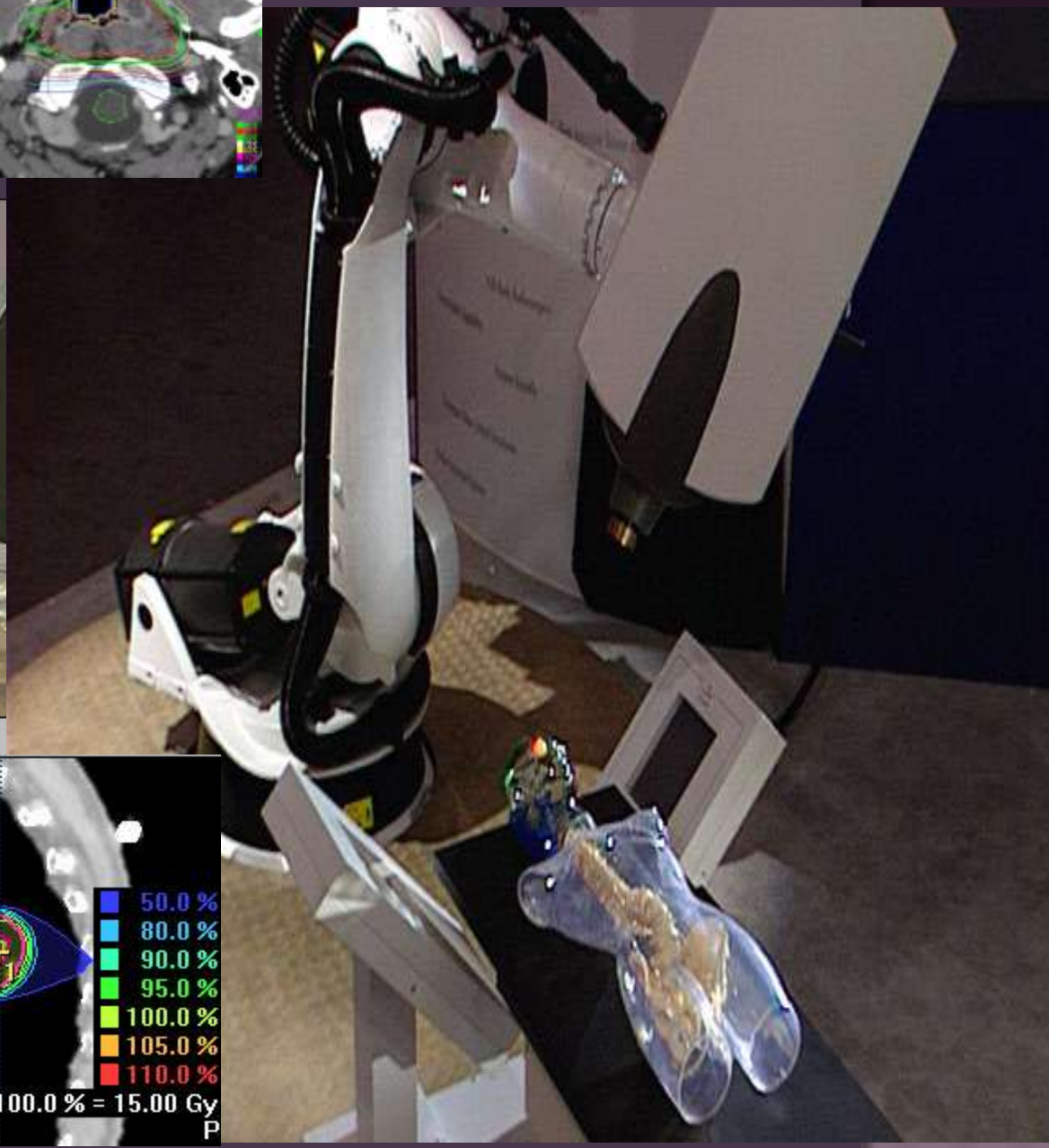


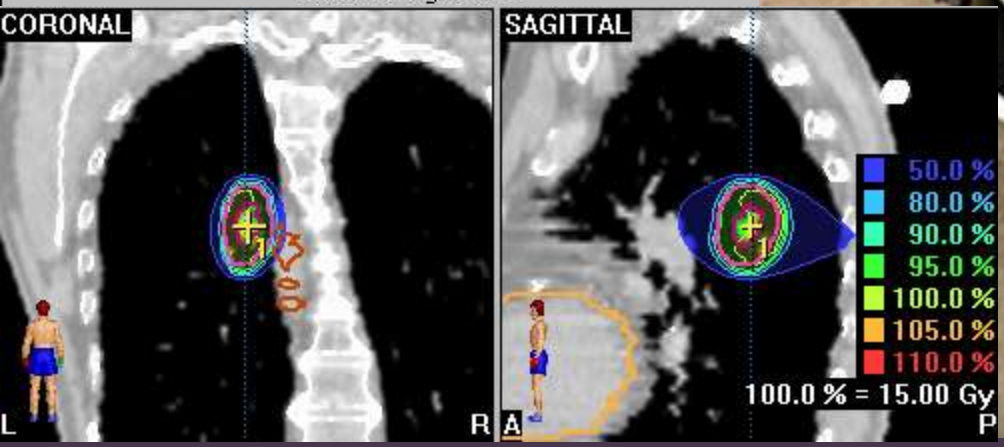
Cyberknife





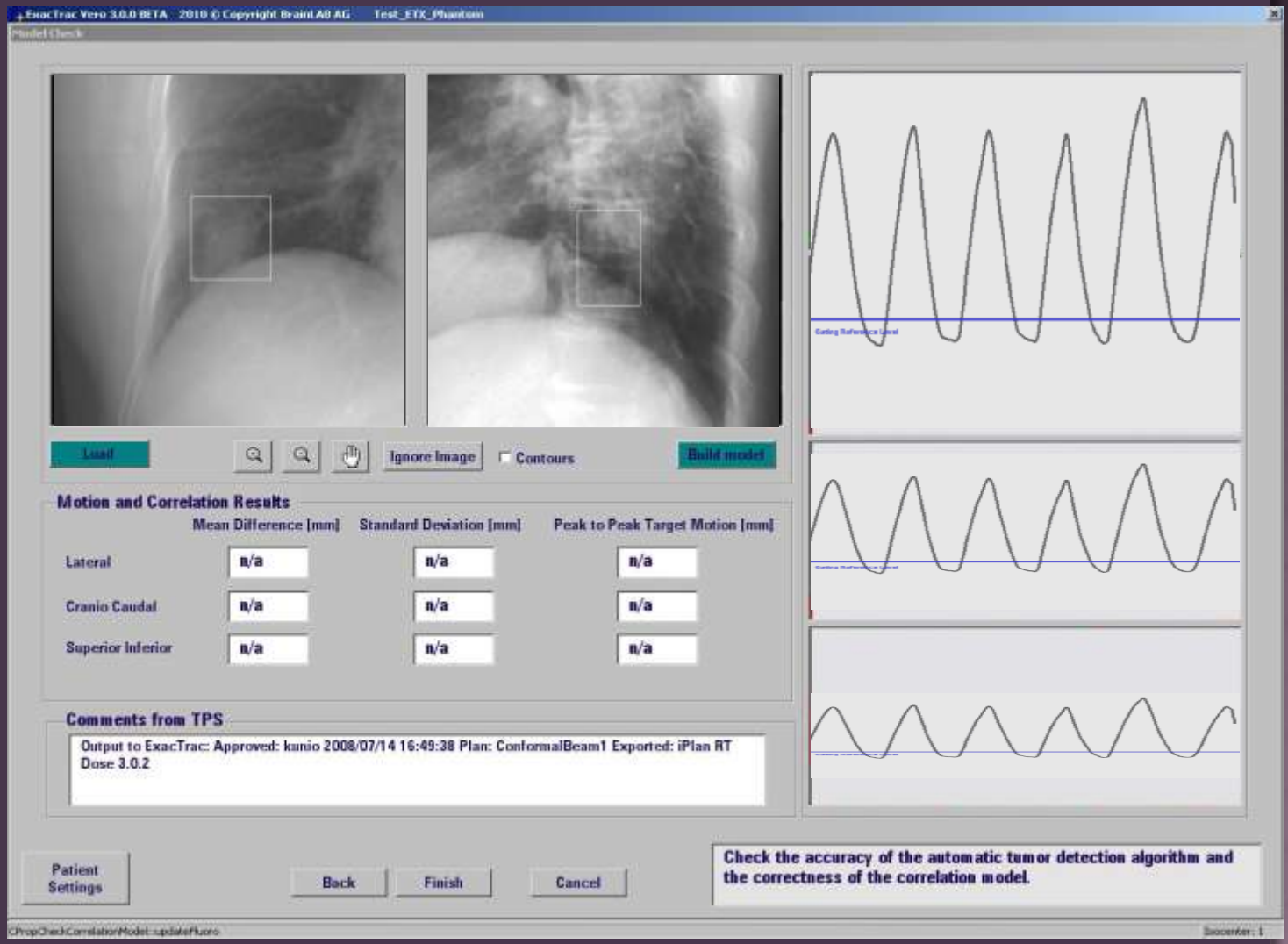
music & logo, 1.52



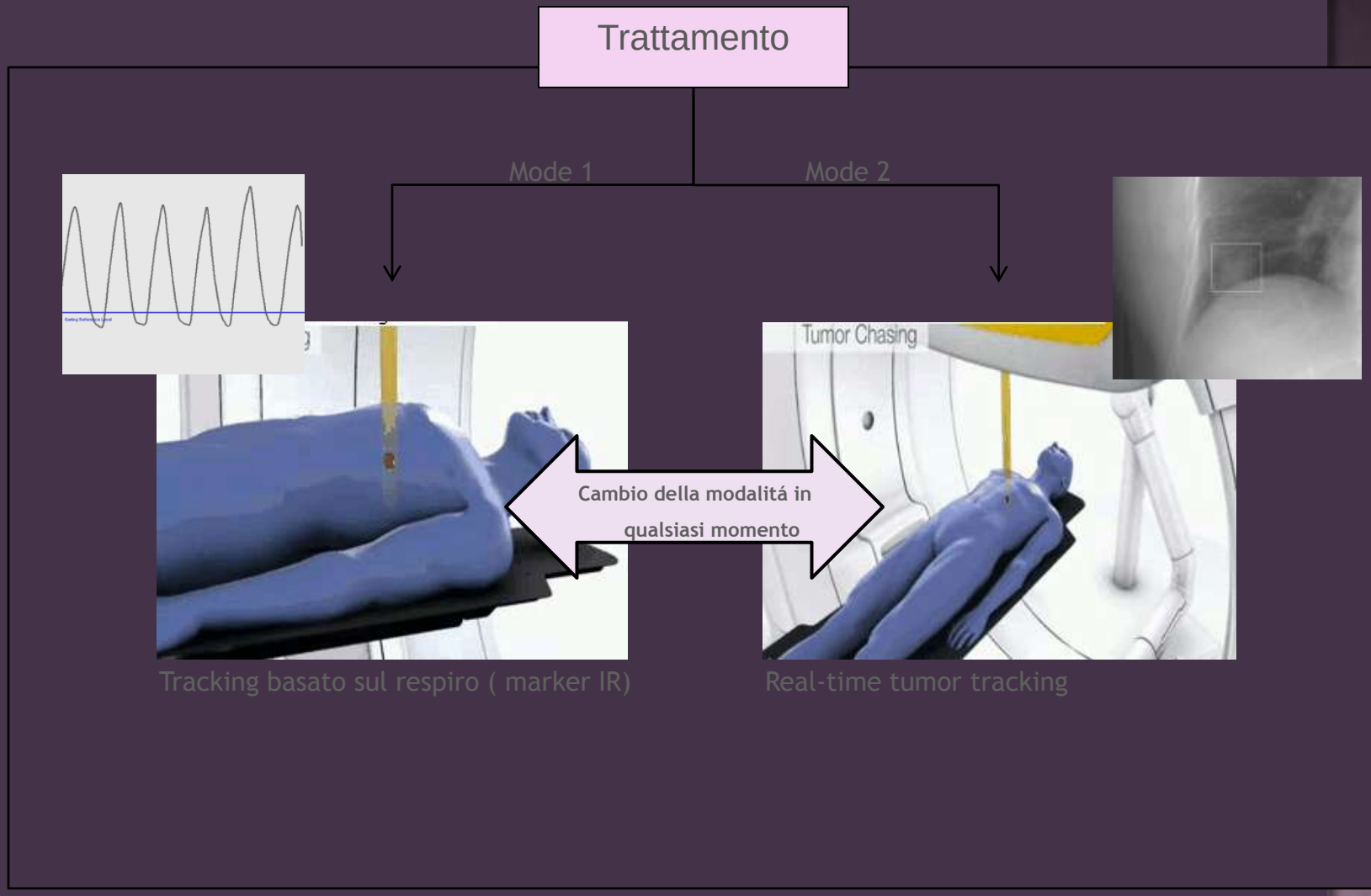



WPO

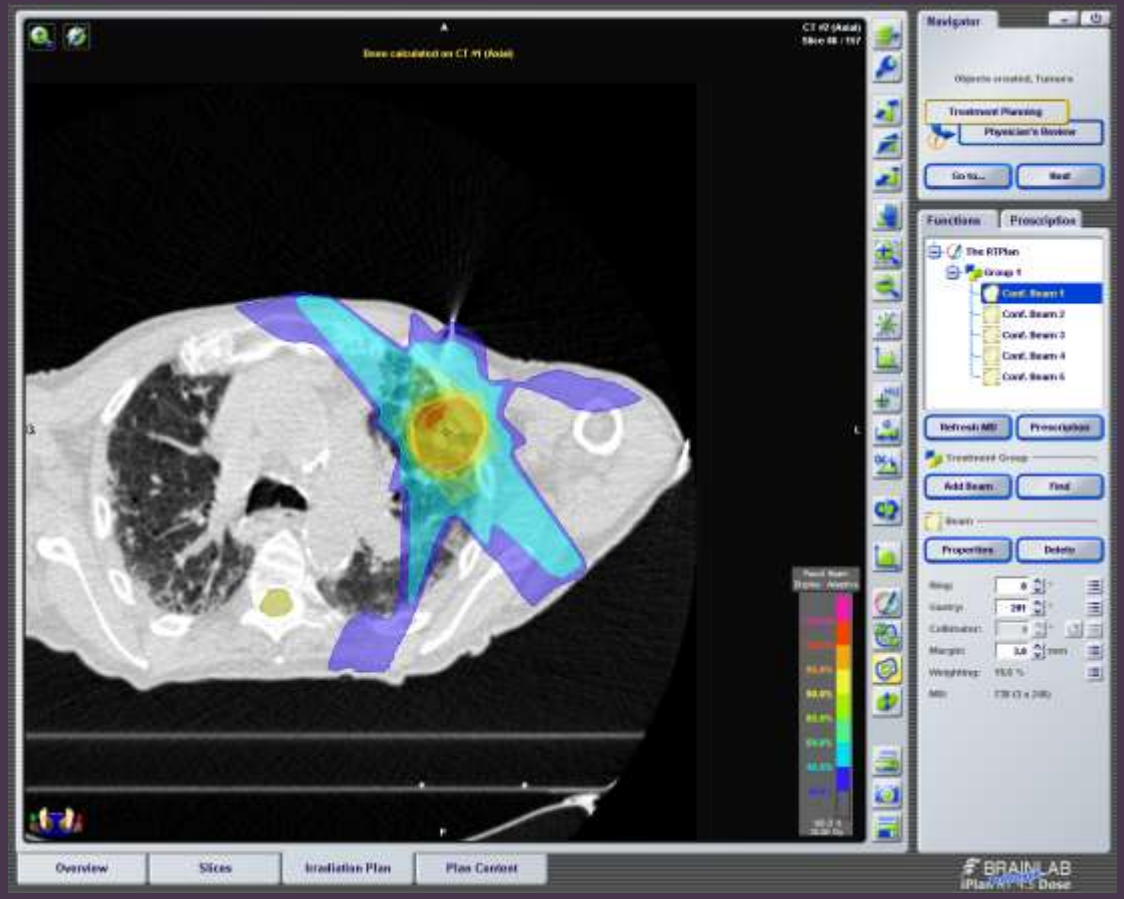
Tracking Dinamico



Tracking Dinamico



Piccola lesione al polmone (senza tracking)

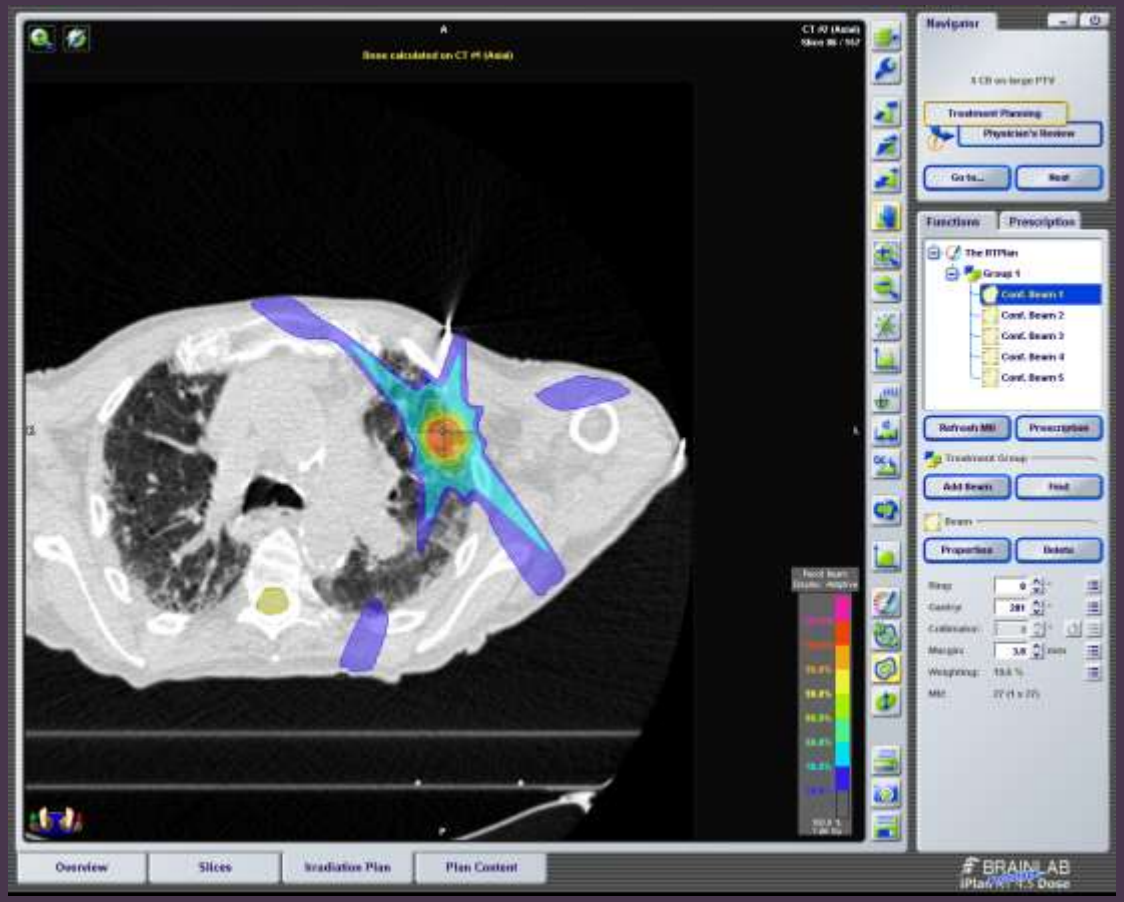


- 5 Fasci conformati

Without dynamic tracking treating whole motion envelope with large safety margin

Piccola lesione al polmone (con tracking)

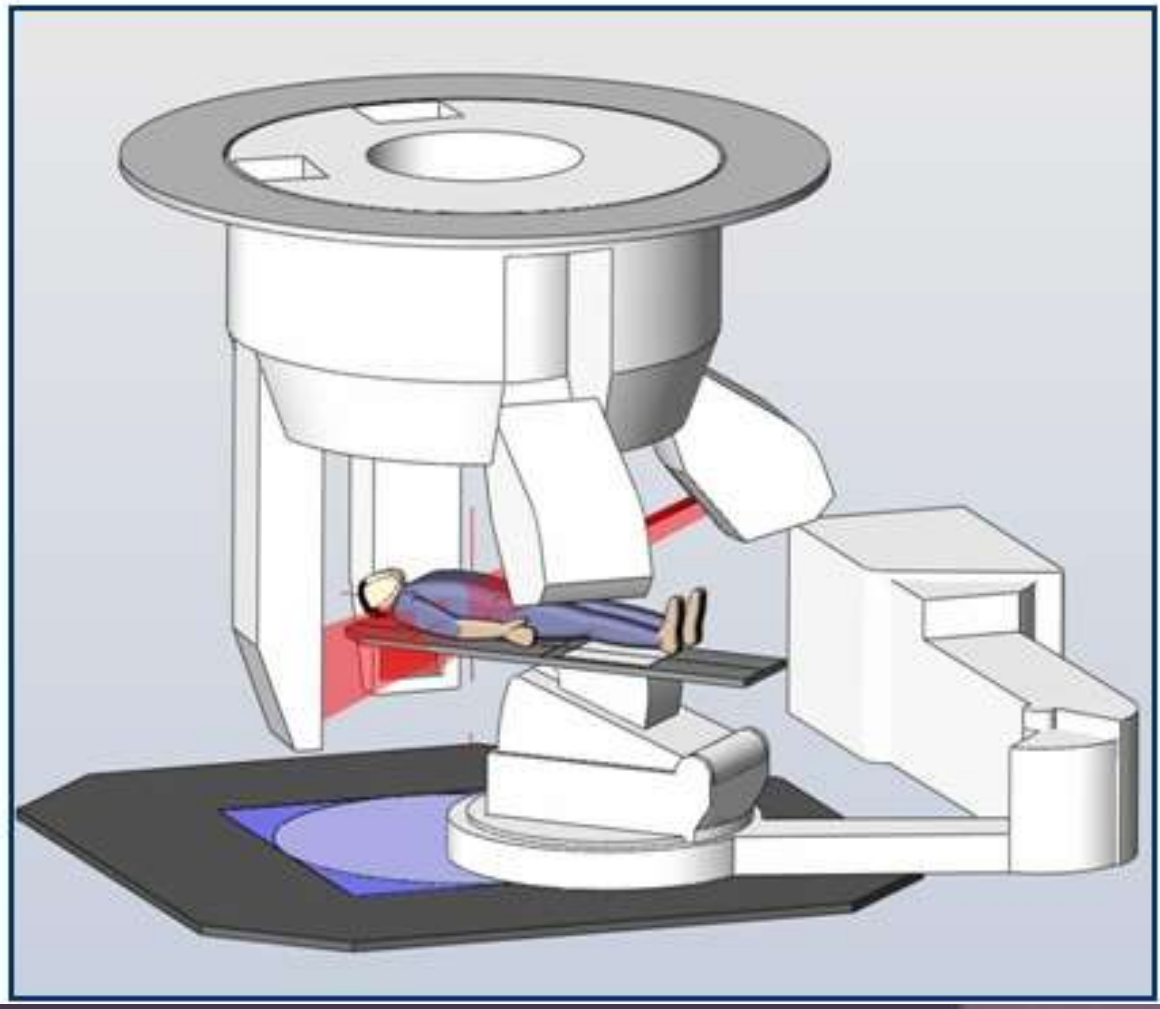
- 5 Fasci conformati
- Focus: Caso di Tracking dinamico



With dynamic tracking, treating tumor and visibly less healthy tissue

6D Patient Positioning System

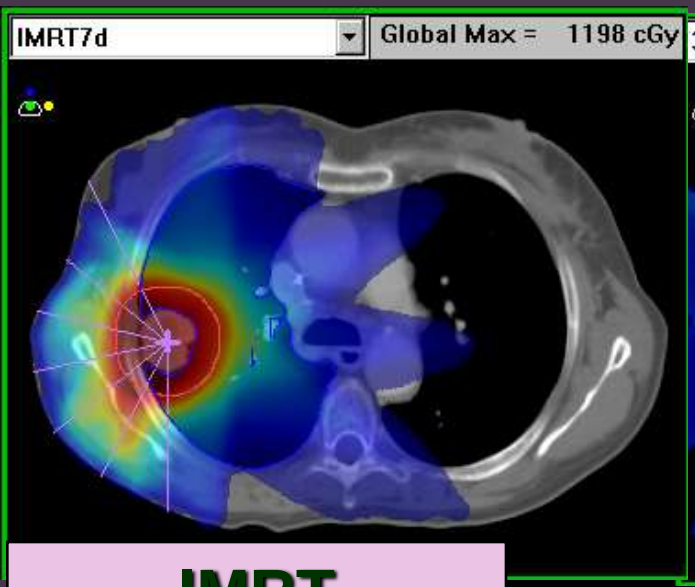
- Extremely high precision (absolute: ±0,3mm ; relative: ± 0,1mm)
- Possibility to couple a chair or couch
- Whole body treatable (with chair: eyes, head and neck)
- Pitch ±30°
- Roll ± 15°
- Vertical travel range min. 600mm
- No pit necessary



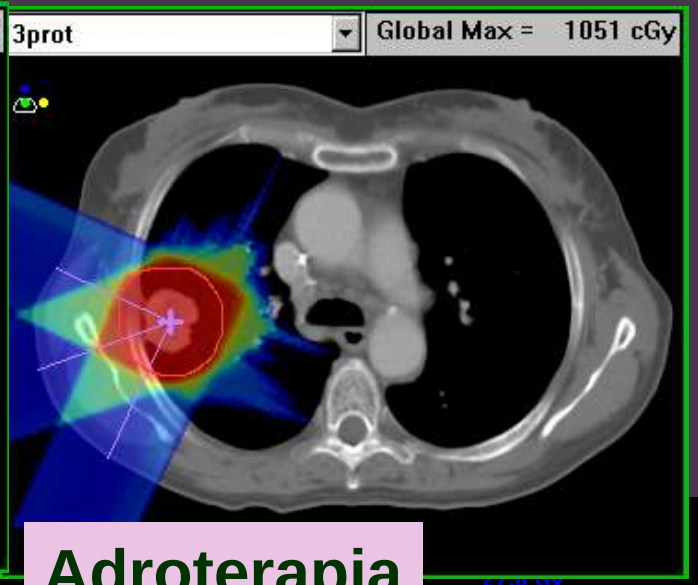
CNAO (National Center for Oncological Hadrontherapy) Pavia, Italy

Courtesy of Schaer Engineering AG, Switzerland

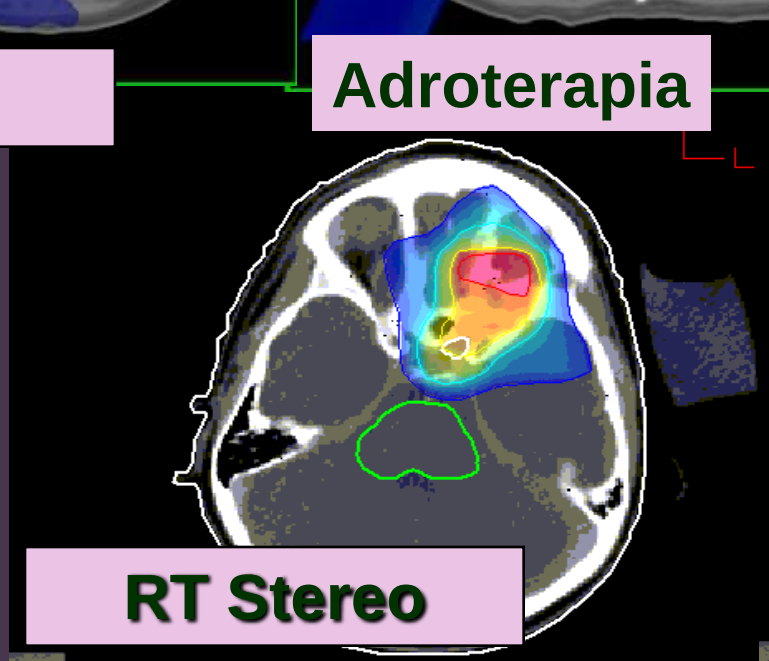
Selettività Fisica



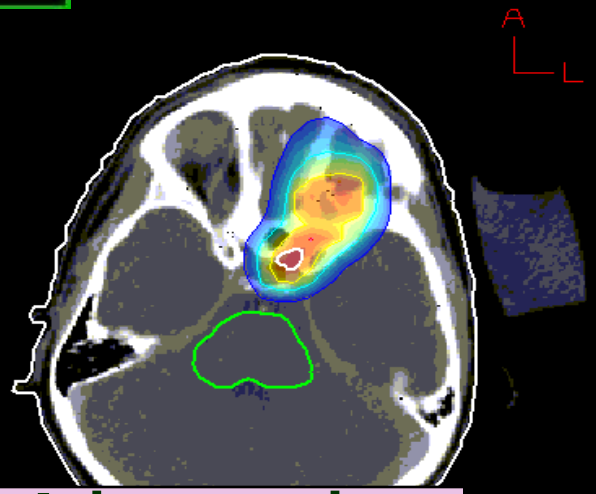
IMRT



Adroterapia

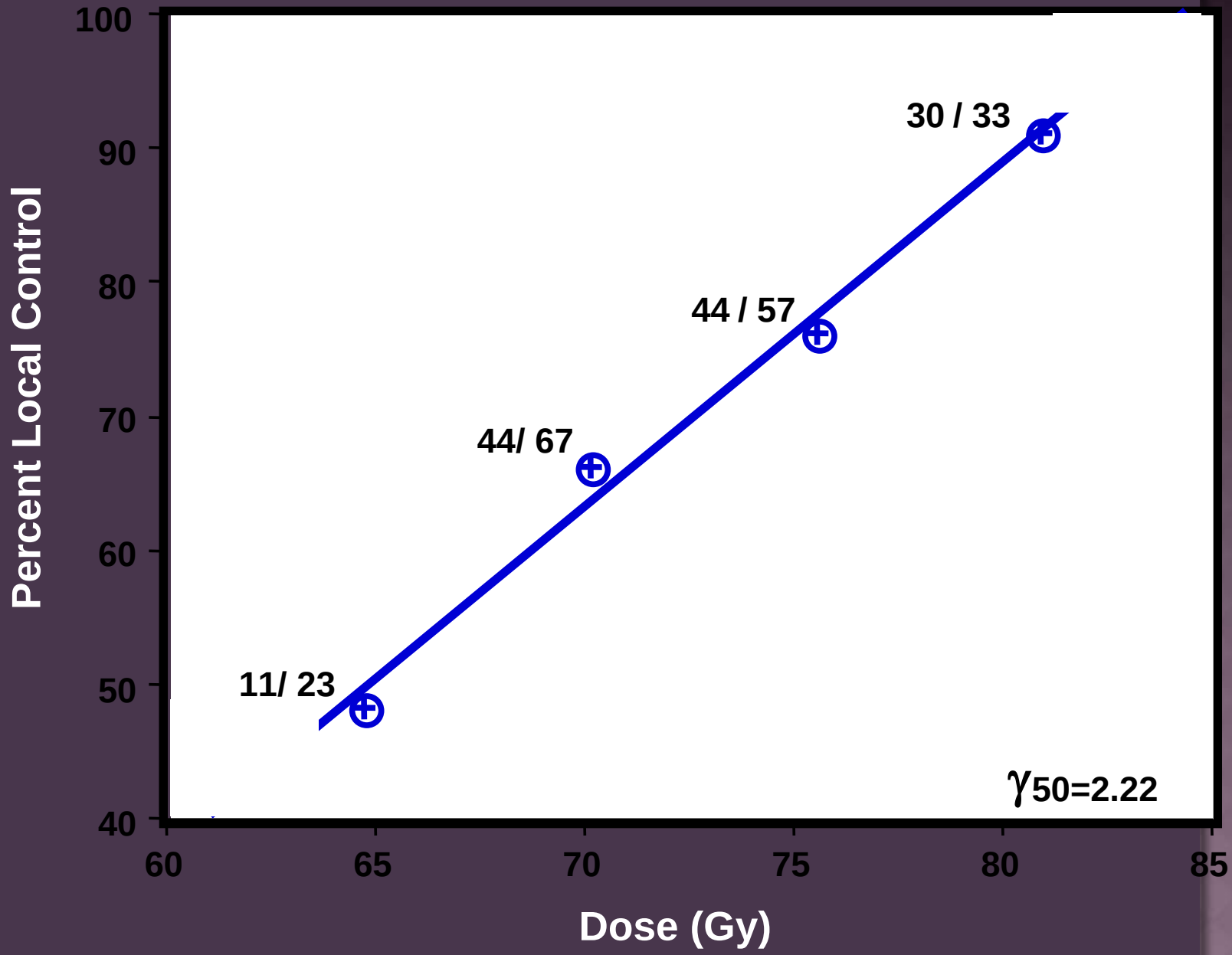


RT Stereo



Adroterapia

Local Control by dose



GOAL

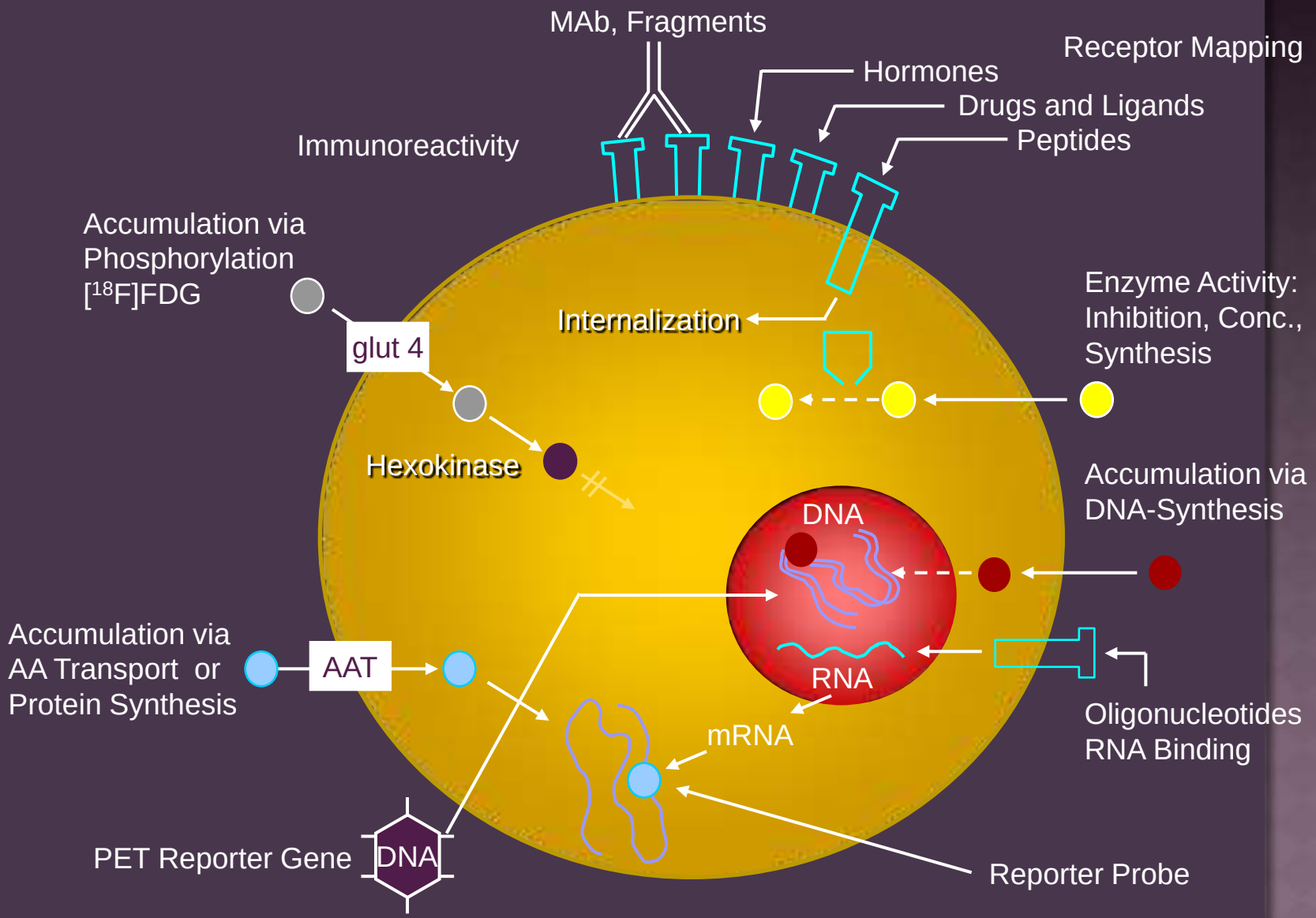




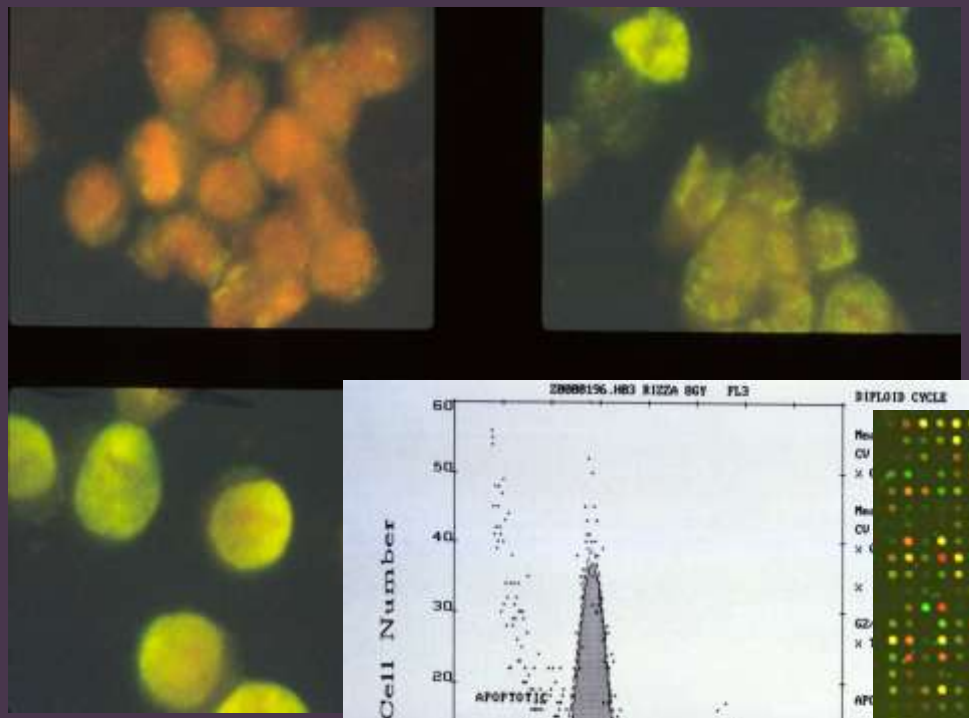
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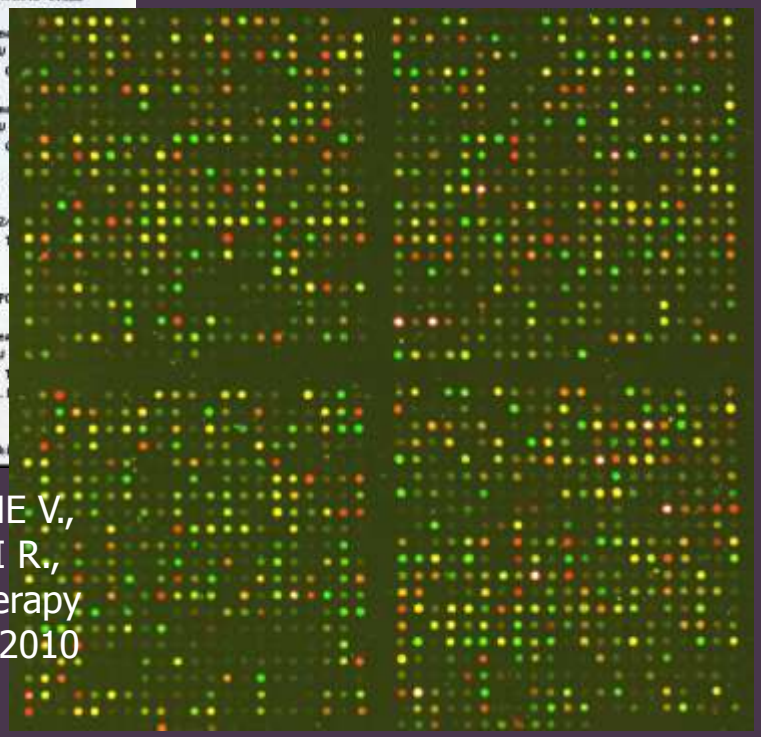
INDIVIDUALIZED THERAPY

CELLULAR TARGETS



MOLECULAR RADIATION THERAPY





STERPONE S., CORNETTA T., PADUA L.,MASTELLONE V., GIAMMARINO D., TESTA A., TIRINDELLI D., COZZI R., **DONATO V**. Dna repair capacity and acute radiotherapy adverse in Italian breast cancer patients Mutat Res 2010 feb 3; 684 (1-2): 43-48

OLTRE LA TECNICA

È strano che, in contrasto con le straordinarie capacità operative della medicina moderna, sia emersa non di rado una sensazione di fallimento.

Le scoperte delle scienze naturali e della medicina hanno portato ad una competenza senza precedenti. Ma è come se per la massa delle persone ammalate sia divenuto, per ognuna di esse, più difficile trovare il medico giusto.

Verrebbe da pensare che, proprio mentre la tecnica viene continuamente migliorando le proprie capacità, i buoni medici si siano fatti rari.

K. Jaspers