# Il Planning IMRT

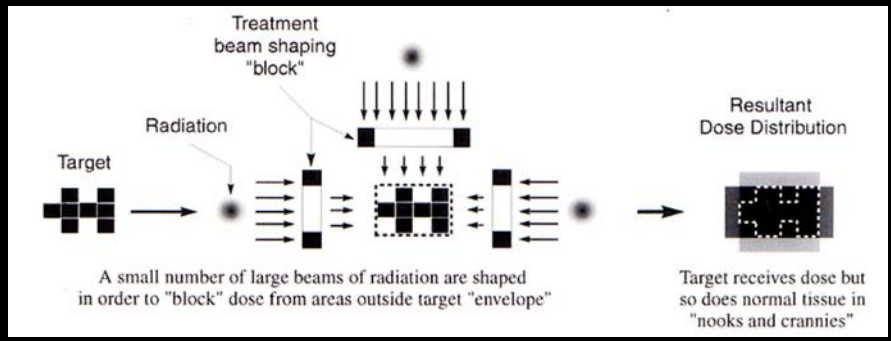
**Corso Teorico Pratico**
**Problematiche tecniche nel planning del carcinoma polmonare non microcitoma**
**Taranto, 21 gennaio 2006**

**Dott. Nicola Perna**

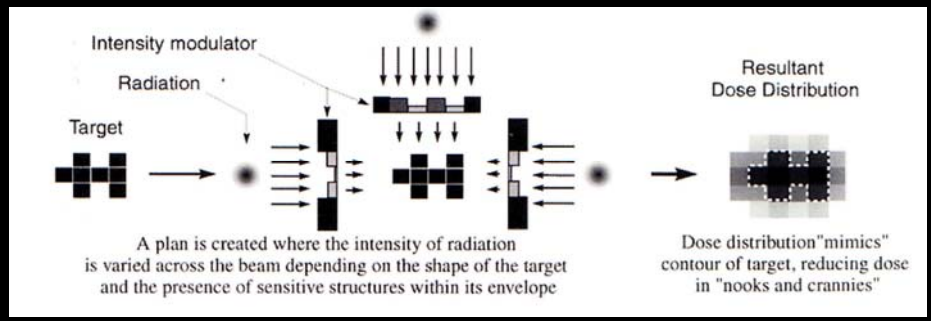
S.C. Radioterapia Oncologica, Presidio Ospedaliero Centrale Stab. San Giuseppe Moscati - A.U.S.L. TA/1 - Taranto

# Introduzione

**L'approccio per un trattamento conformazionale è quello di adattare i campi di irradiazione alla forma del PTV, aumentando il numero dei campi in modo da proteggere eventuali OAR che si trovino all'interno di uno o più campi.**




**L'approccio per un trattamento IMRT è quello di suddividere ciascun campo in tanti *segmenti* al fine di avvicinarsi ad una *mappa teorica di dose.***



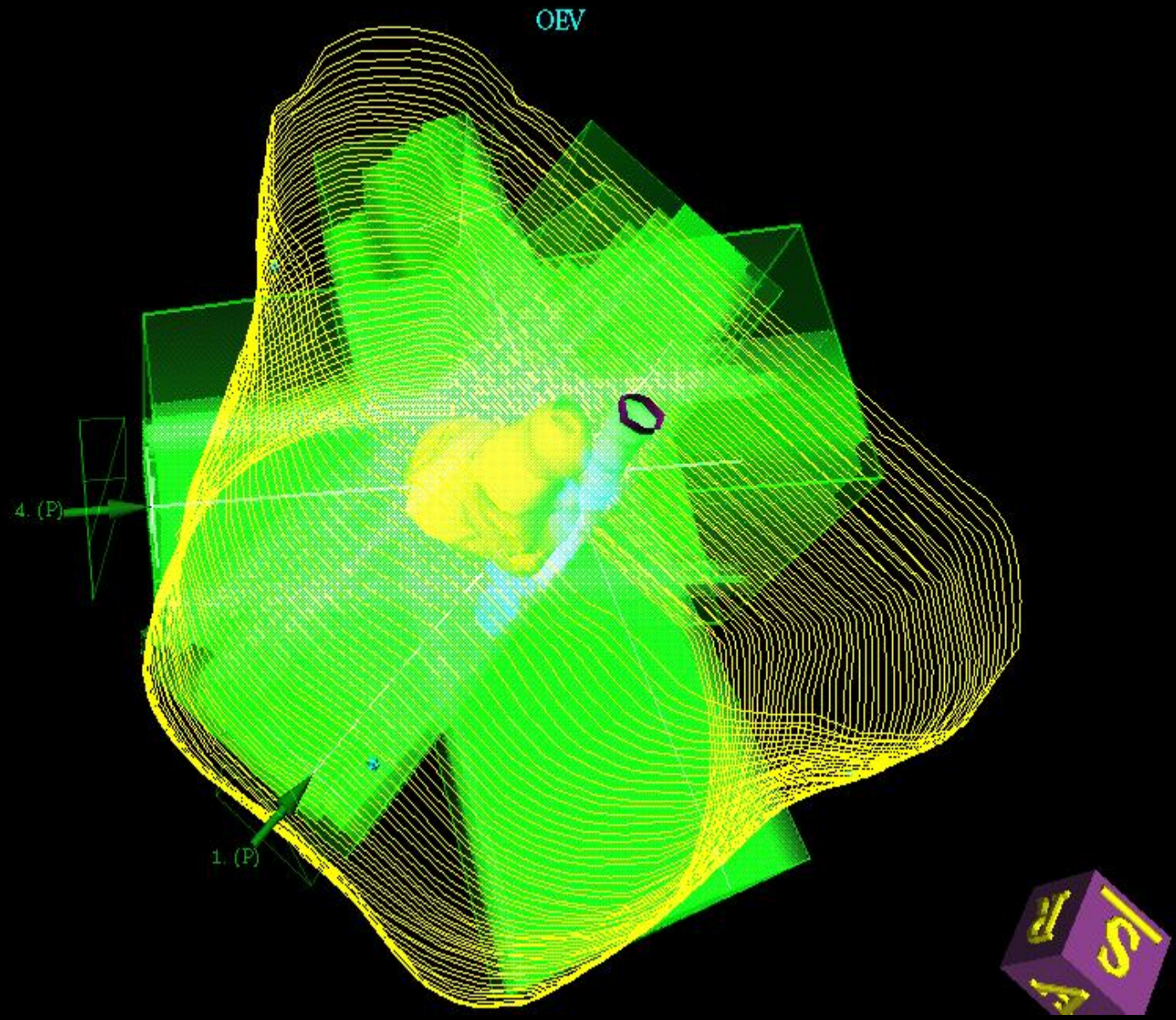
# La IMRT

**La IMRT (*Radioterapia ad Intensità Modulata*) è una nuova tecnica utile nei seguenti casi:**

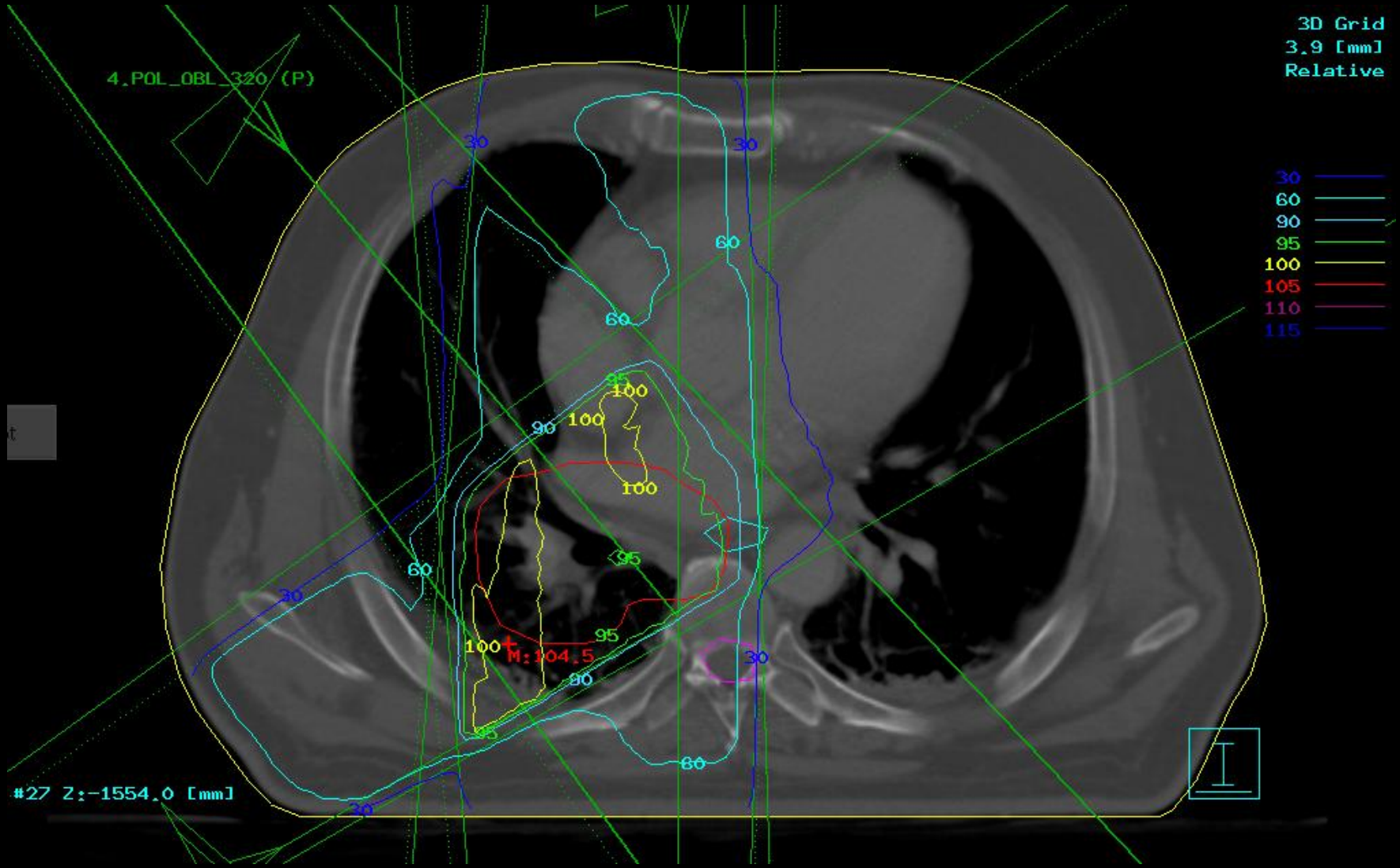
**1) PTV ed OAR contigui;**

**2) PTV di forma irregolare**

# Piano di trattamento conformazionale



# Piano di trattamento conformazionale

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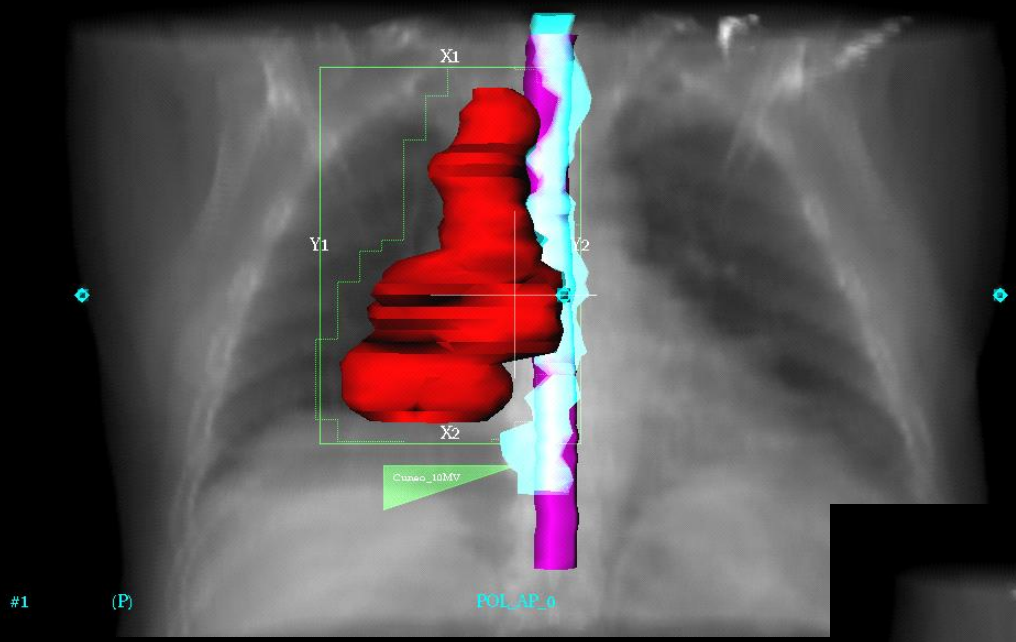
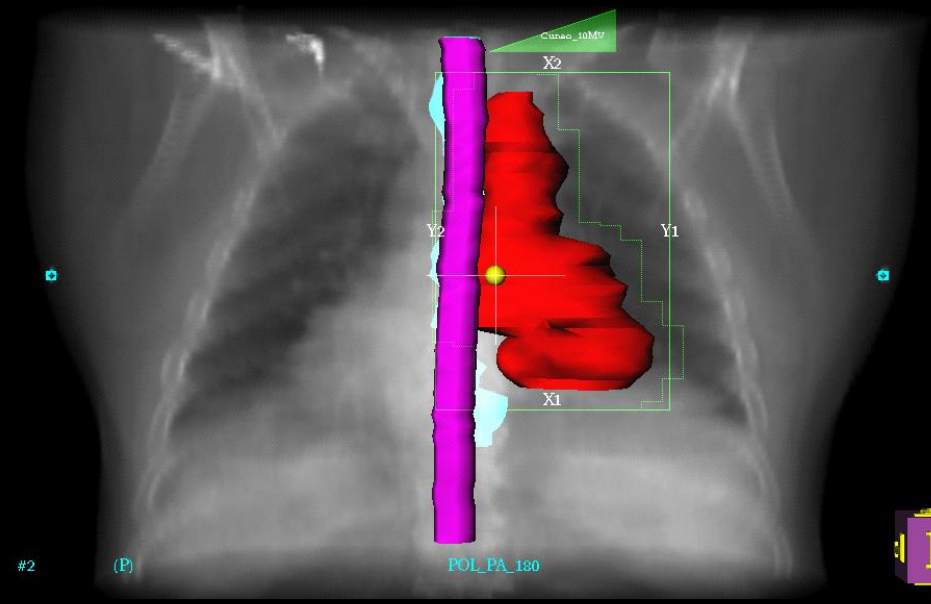
# Piano di trattamento conformazionale

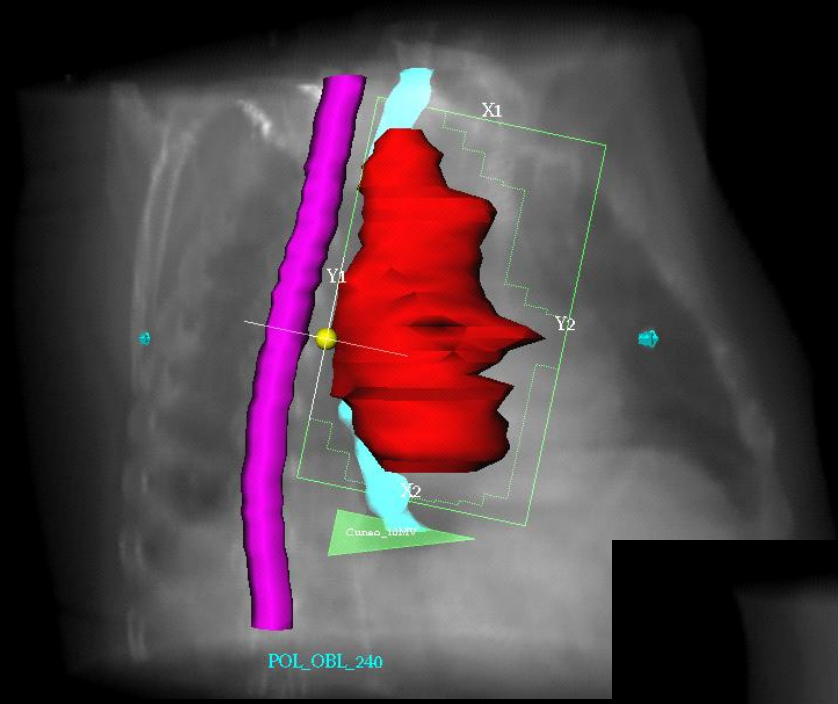



POL_AP_0

POL_PA_180

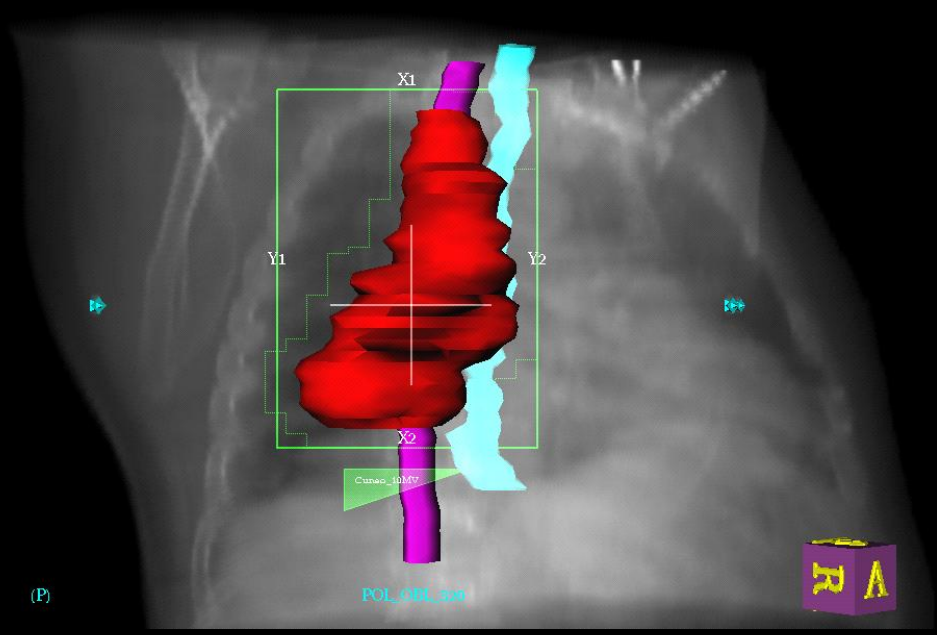


# Piano di trattamento conformazionale




POL_OBL_240

POL_OBL_320



# Piano di trattamento conformazionale

EVAL 3.0.2

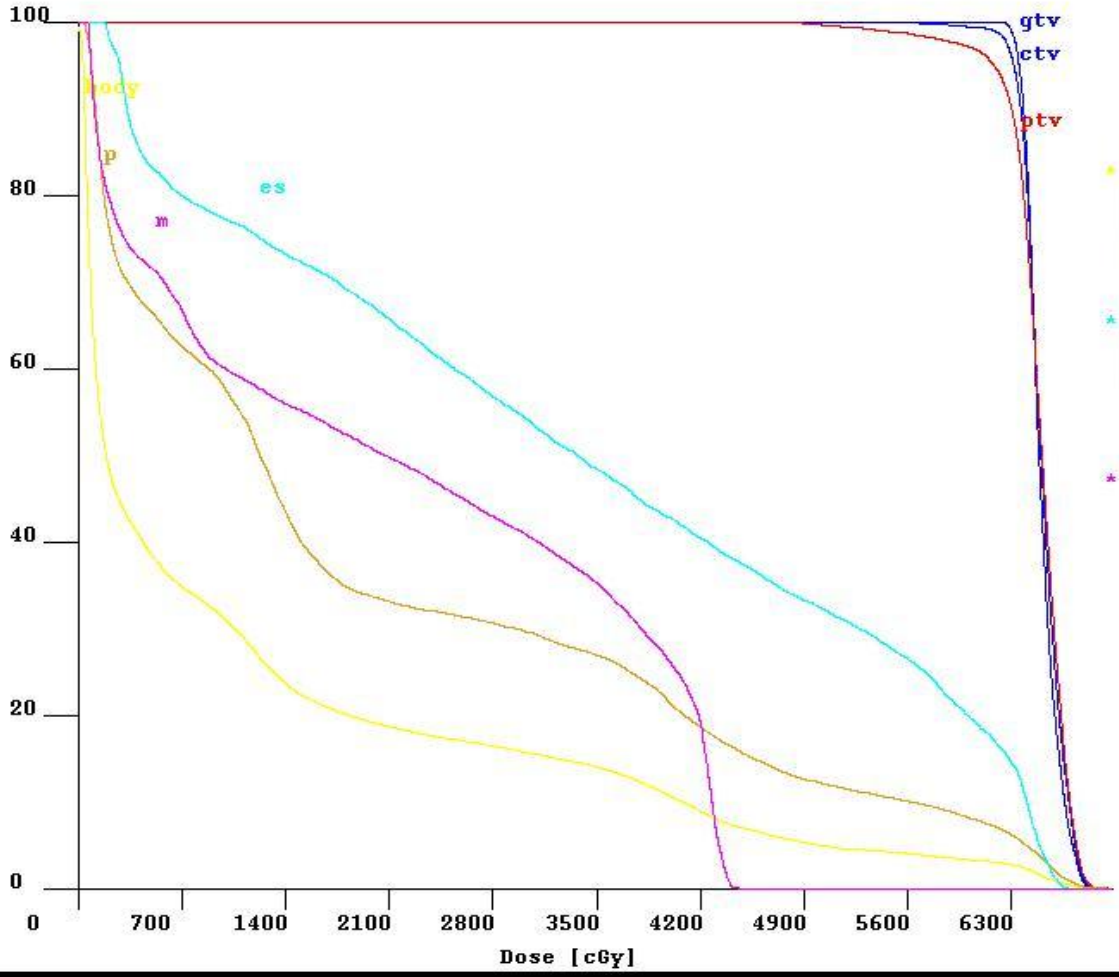
20050751
Dose Volume Histogram
(Integral)

20050751.EVAL_2
01/05/2006, 11:50:45

Dose displayed:
Ext.Beam total dose as in RTS

Brachytherapy:Not loaded
External Beam:1 plan loaded
Transformation:Not calculated

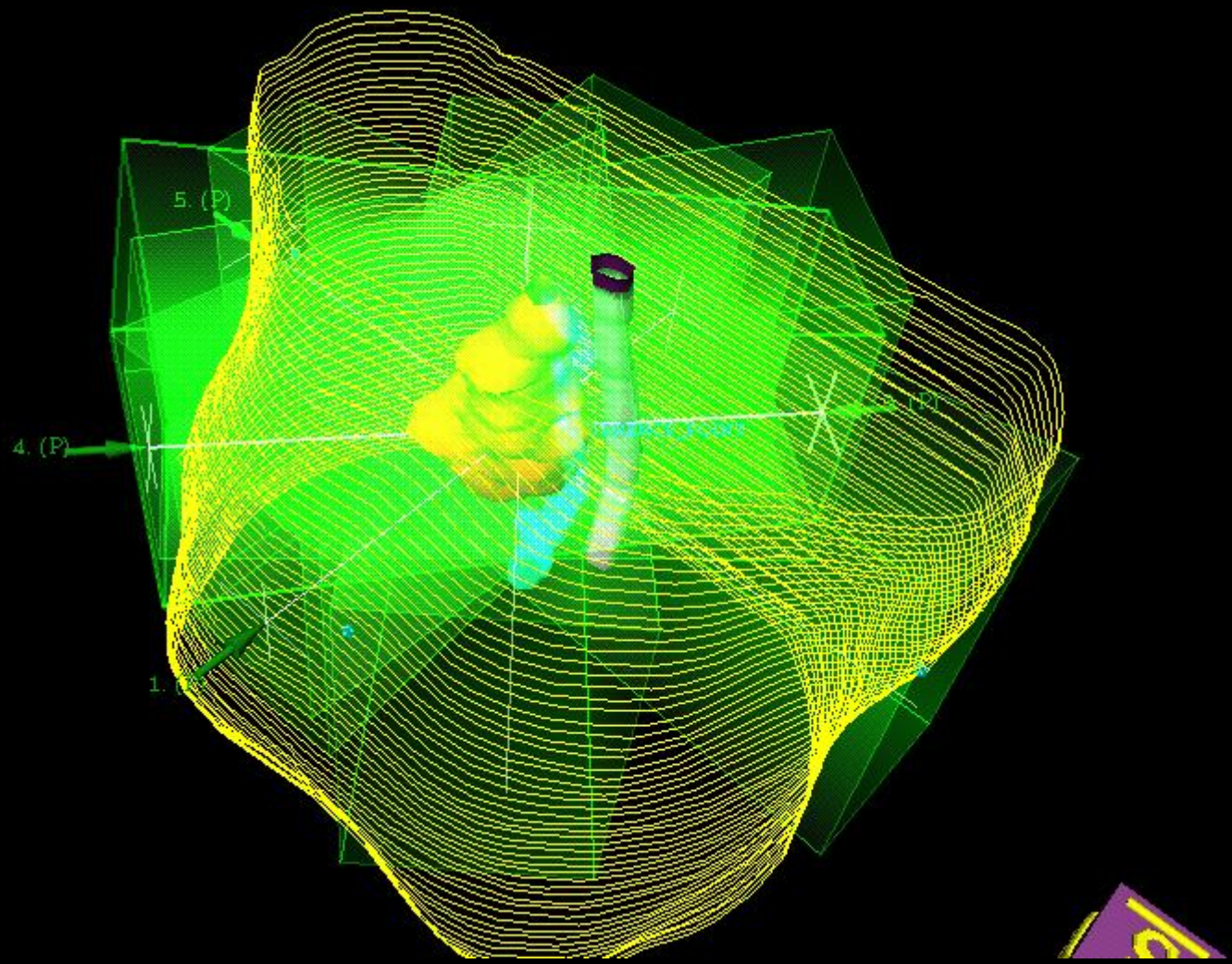
Volume [%]  # of points: 100000
Max. Dose [cGy]: 6976




| | VOI | Vol. (cc) | Area (%) | Dose (cGy) Max | Min | Avg. |
|---|---|---|---|---|---|---|
| | gtv | 123.1 | 93 | 6870 | 6067 | 6501 |
| | ctv | 225.3 | 93 | 6915 | 5135 | 6505 |
| * | body | 23372 | 15 | 6897 | 0 | 1114 |
| | ptv | 376.7 | 92 | 6945 | 4574 | 6479 |
| | p | 3253.8 | 28 | 6936 | 31 | 2007 |
| * | es | 35.9 | 48 | 6676 | 176 | 3399 |
| | m | 57.2 | 30 | 4455 | 65 | 2152 |

* (could be incomplete)

# Piano di trattamento IMRT

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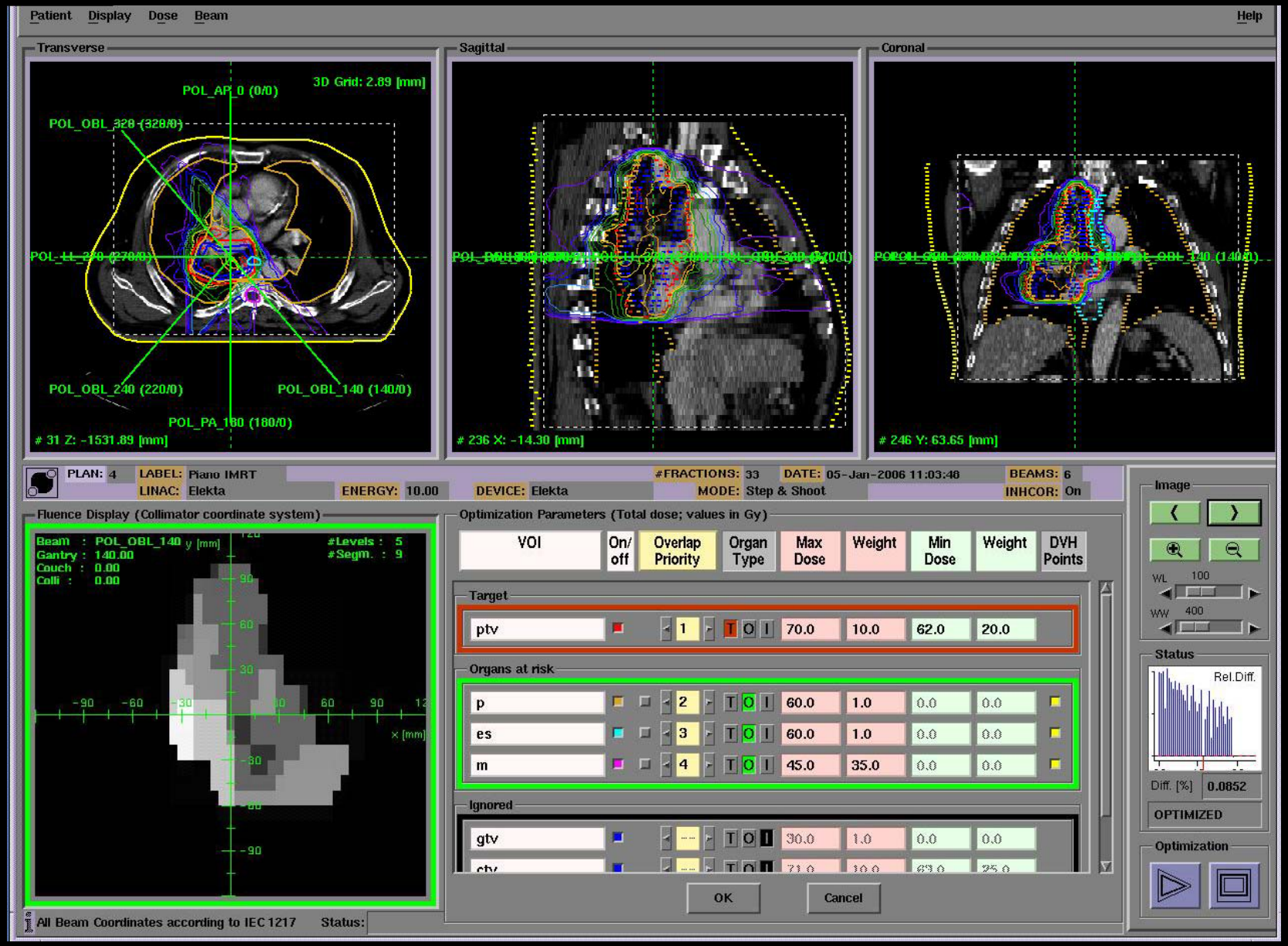
# Piano di trattamento IMRT

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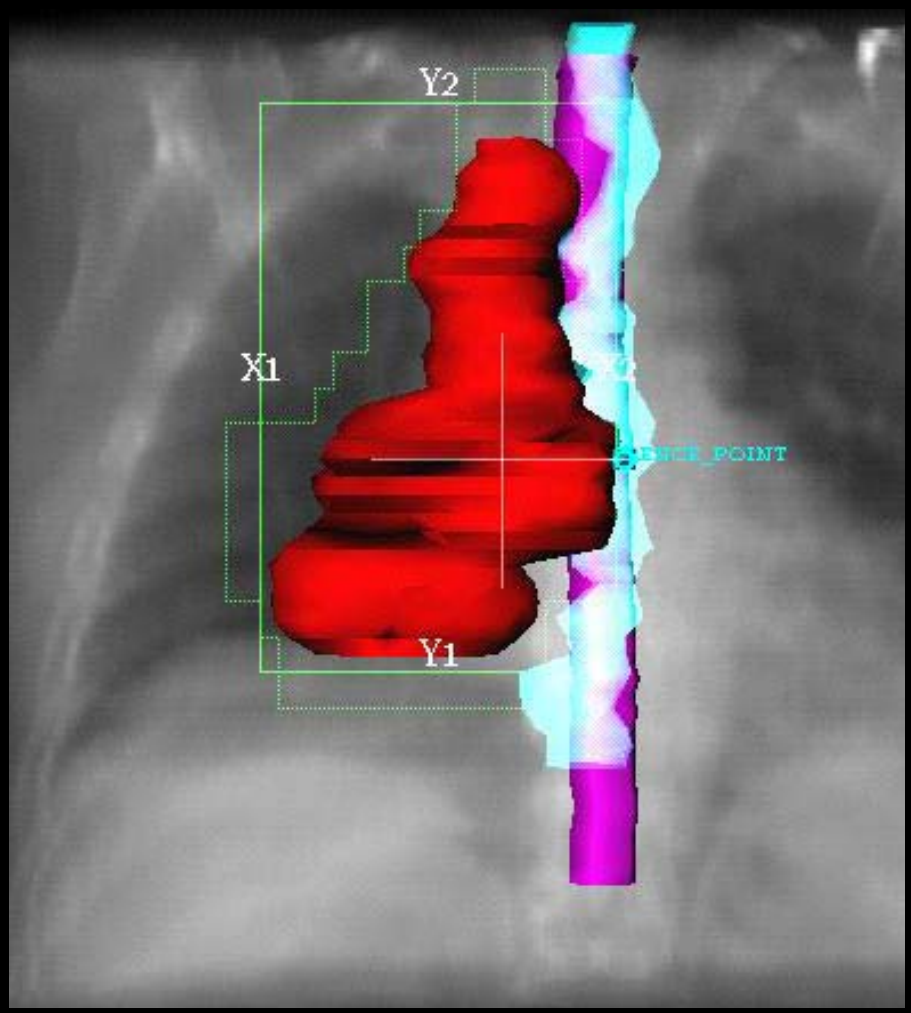
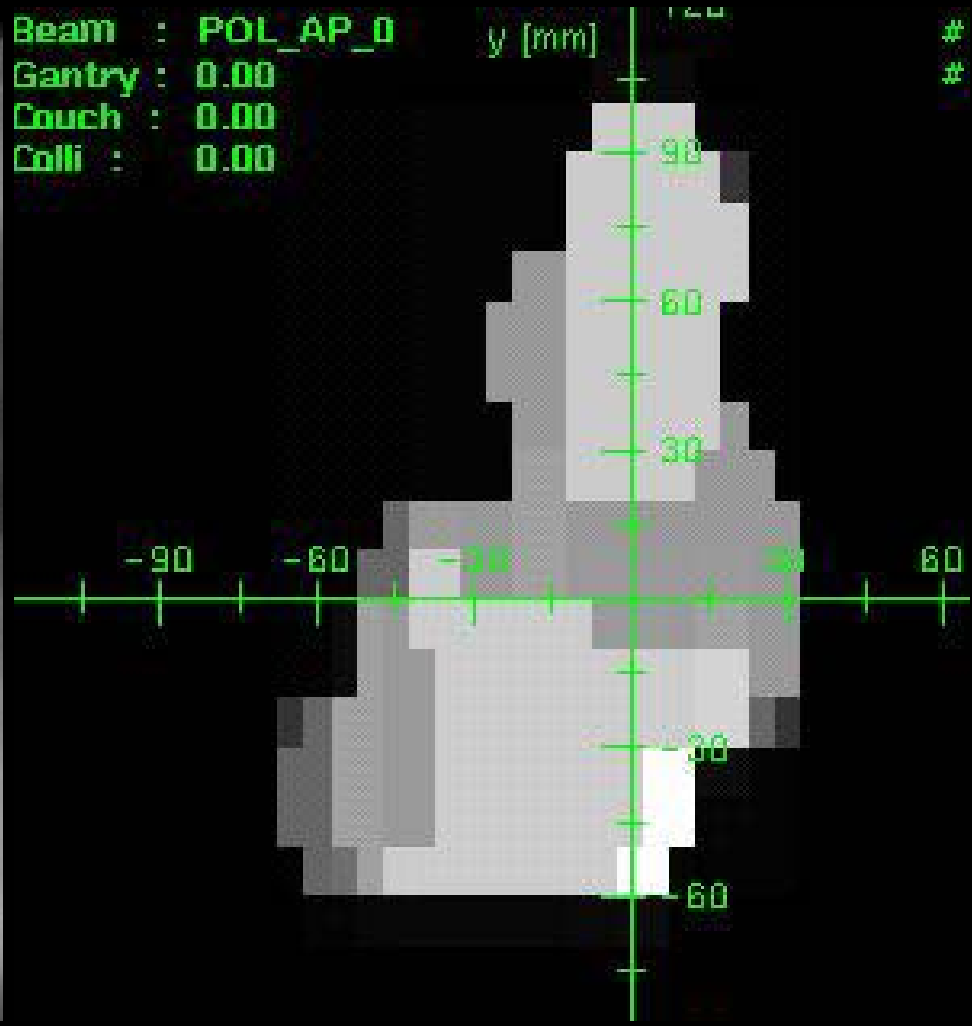
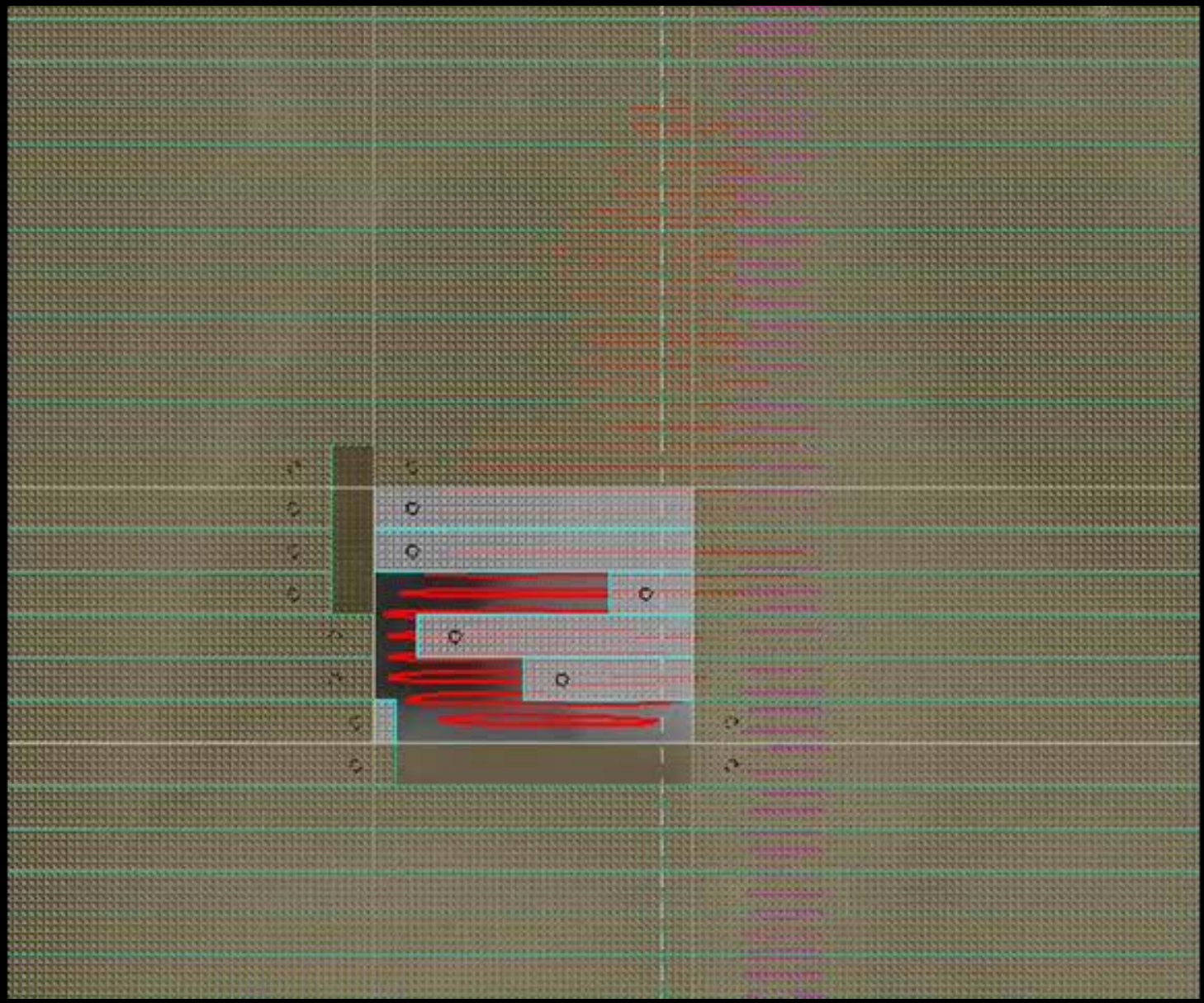
# Campo Anteriore

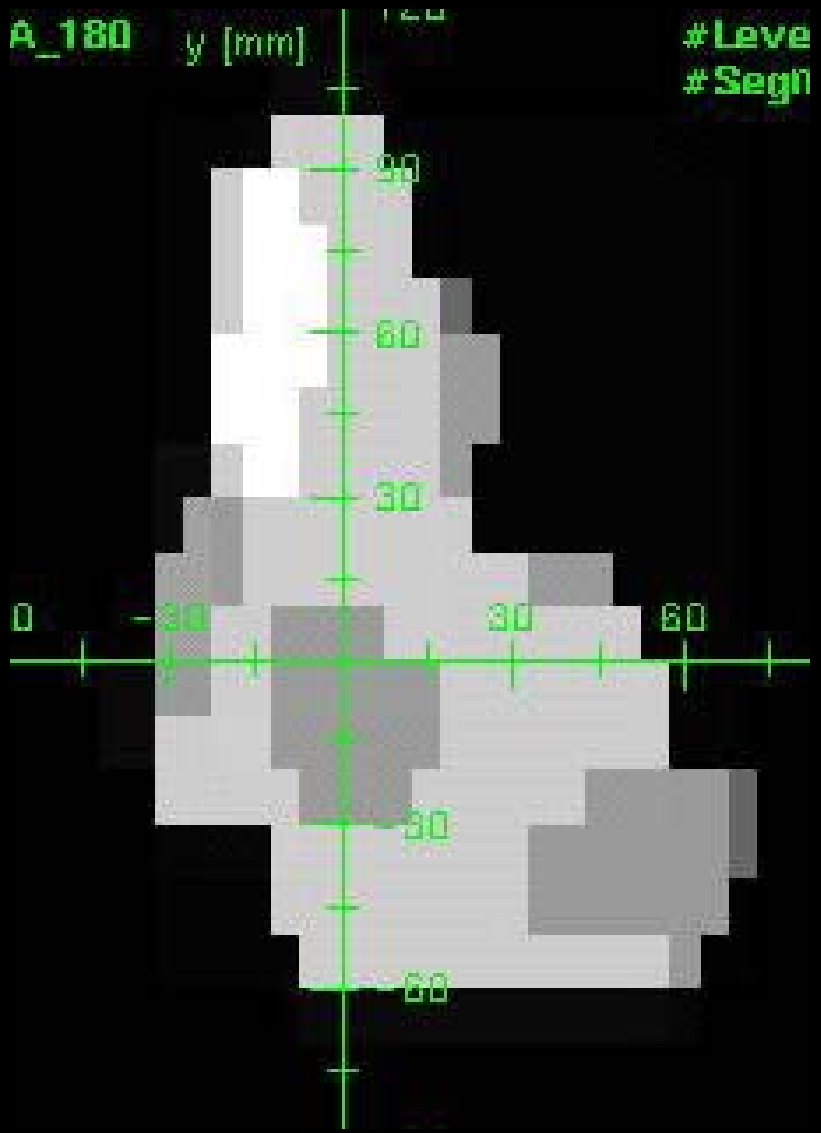


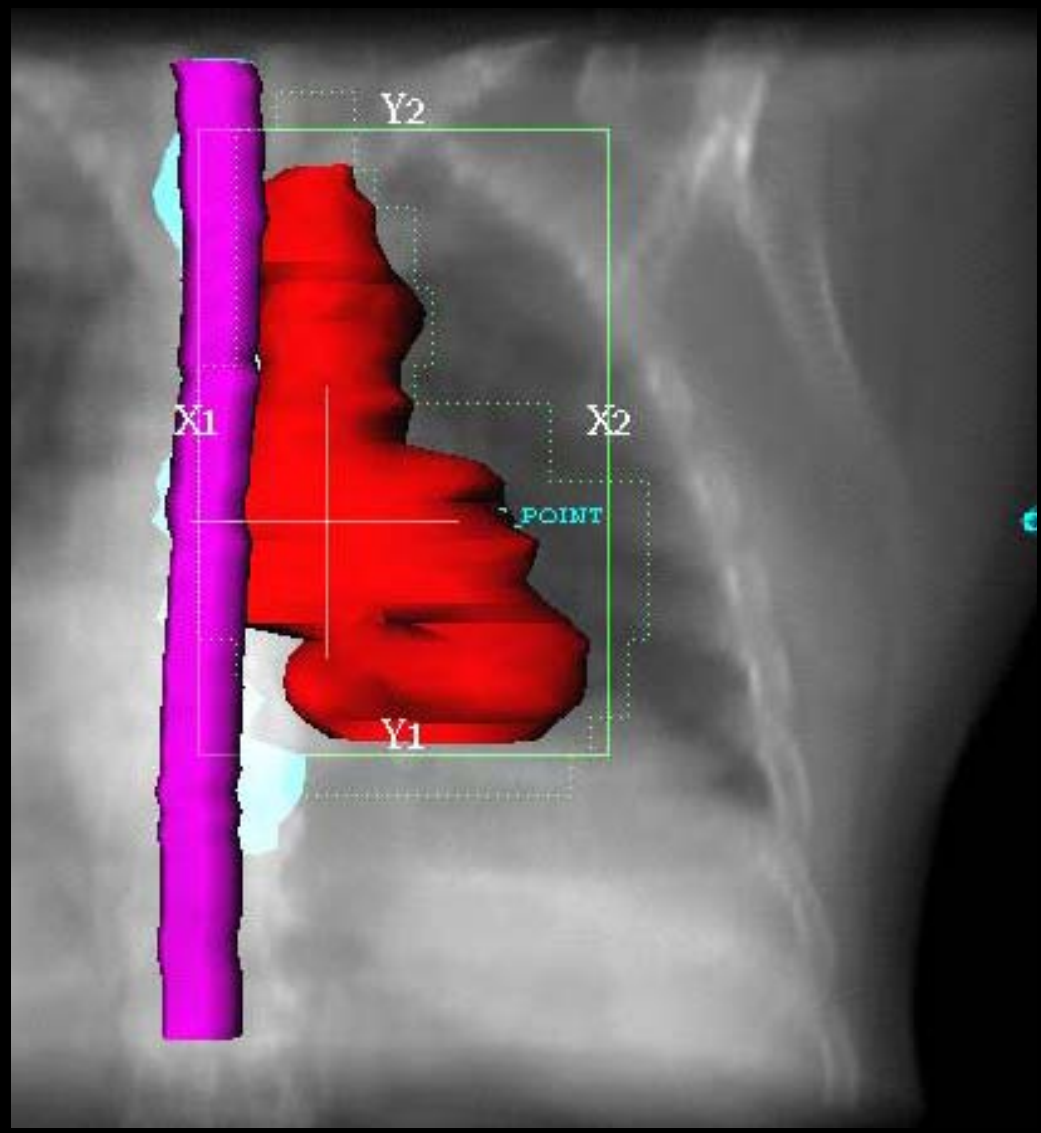



# Campo Anteriore

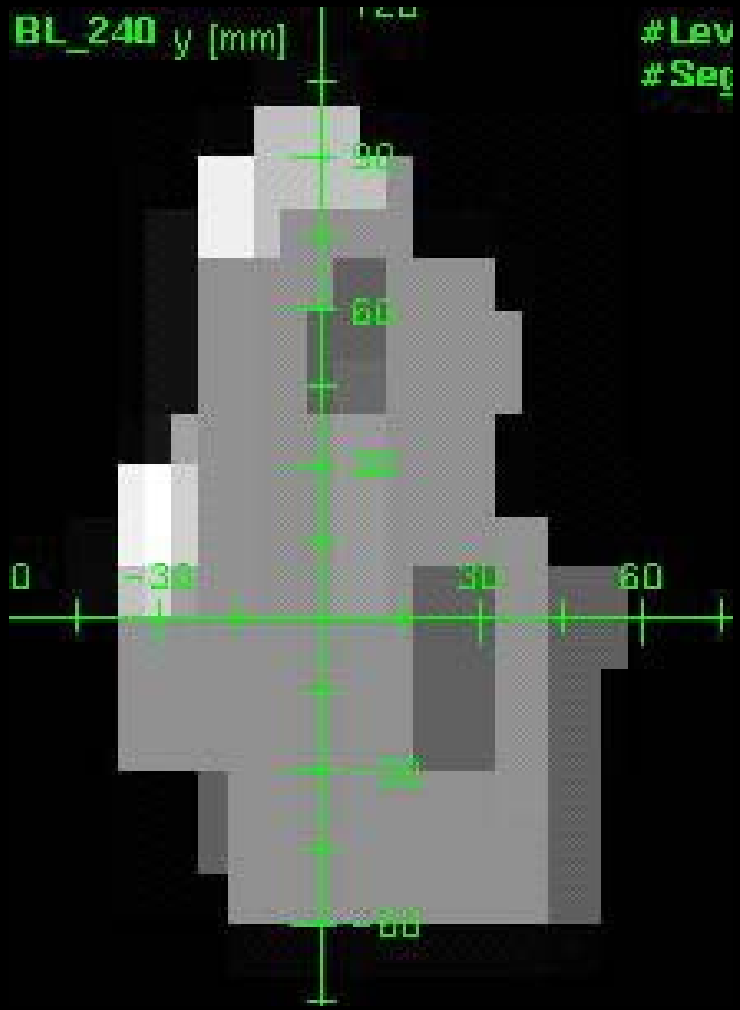


# Campo Posteriore

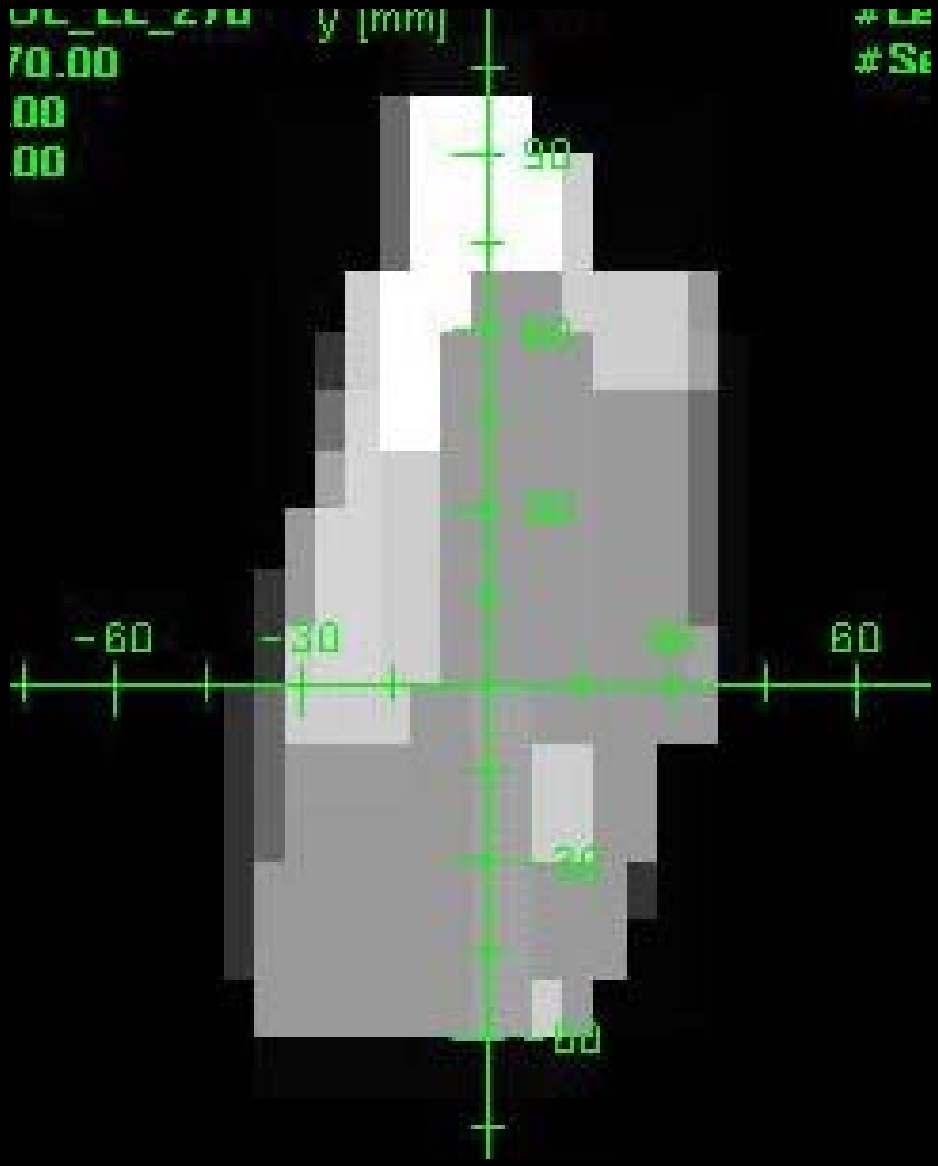


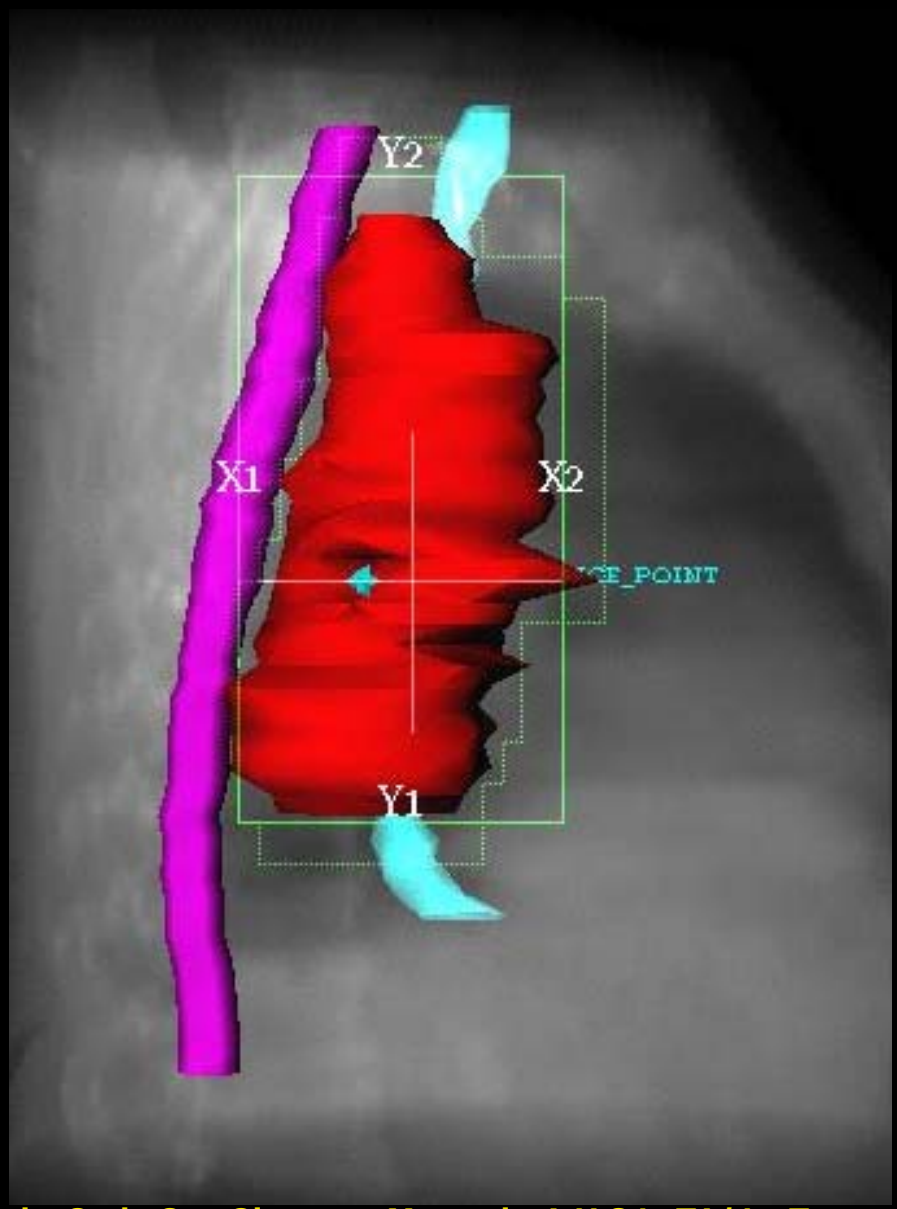



# Campo Obliquo a 240°

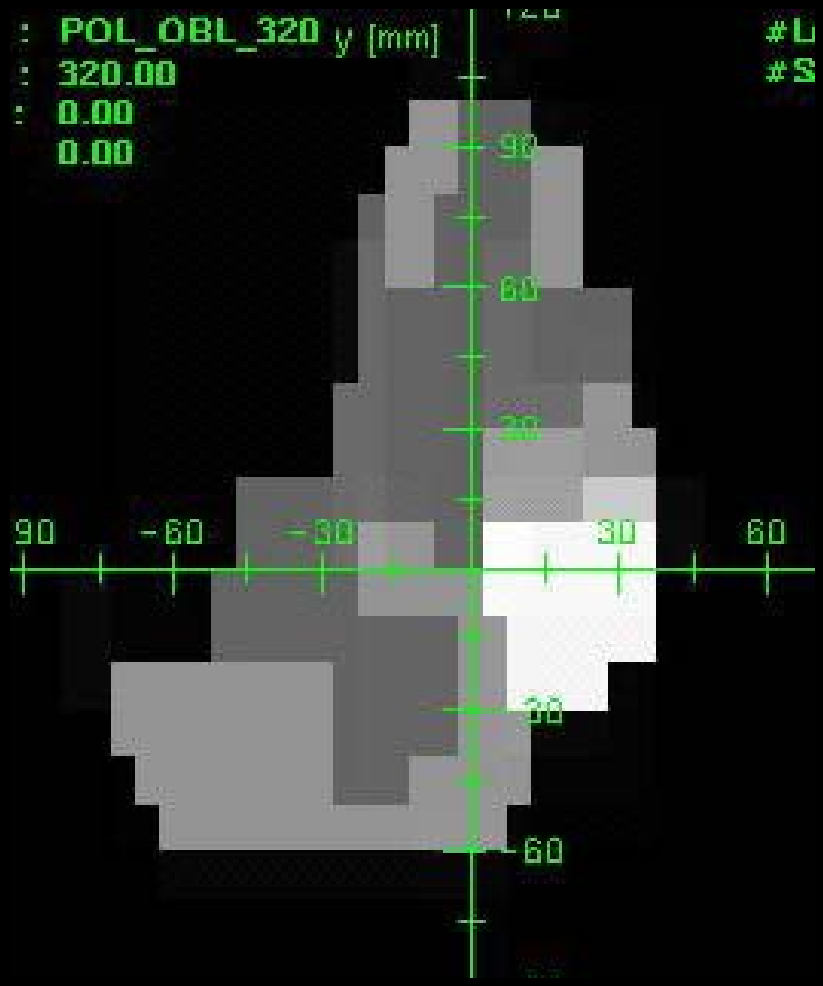


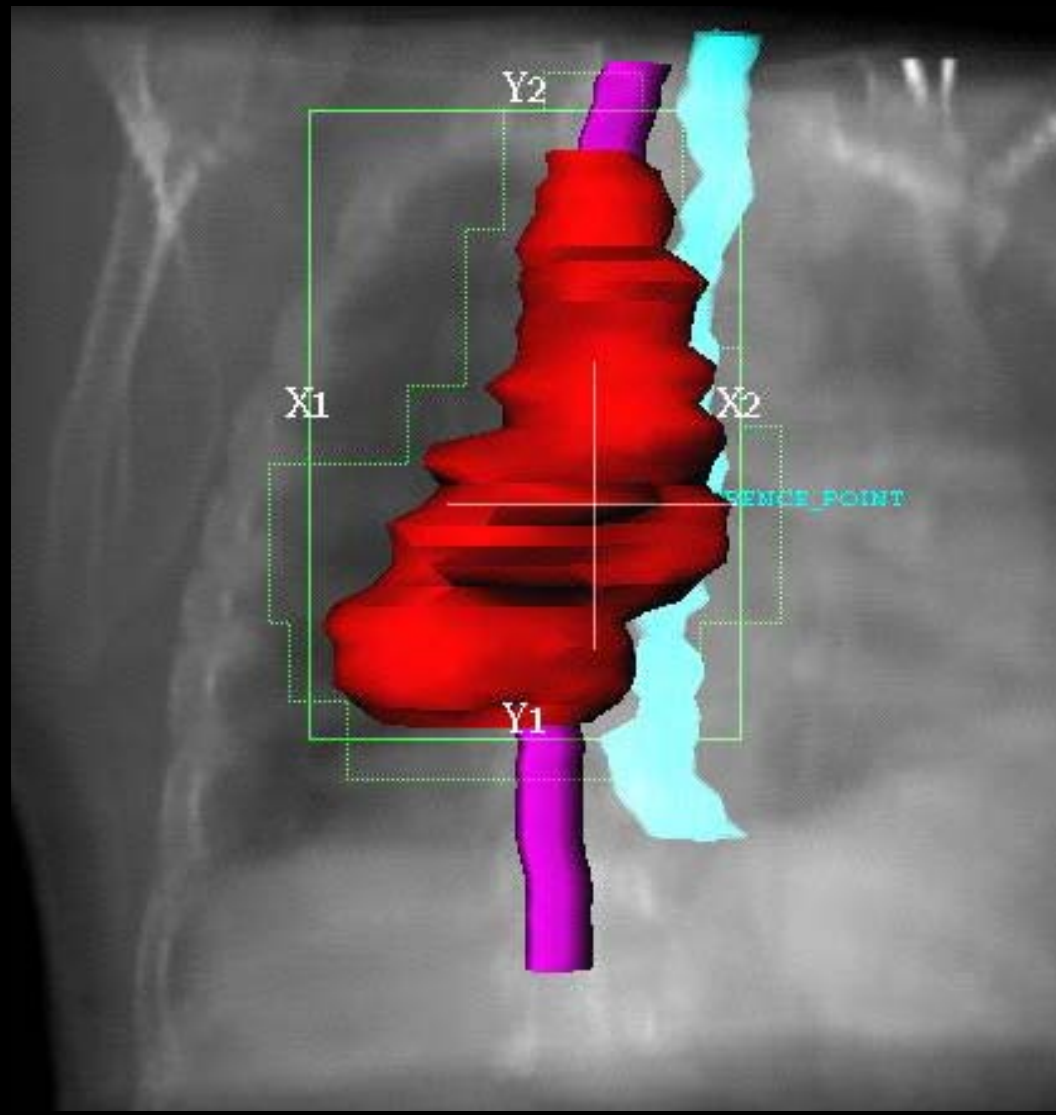

# Campo Laterale 270°



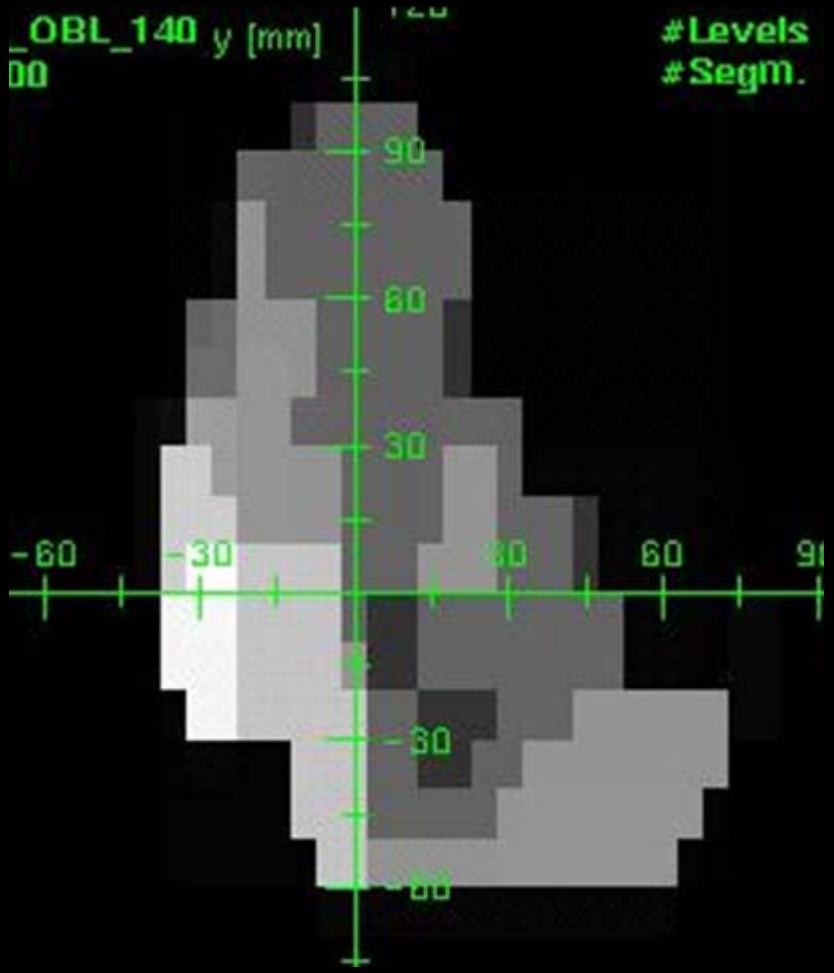



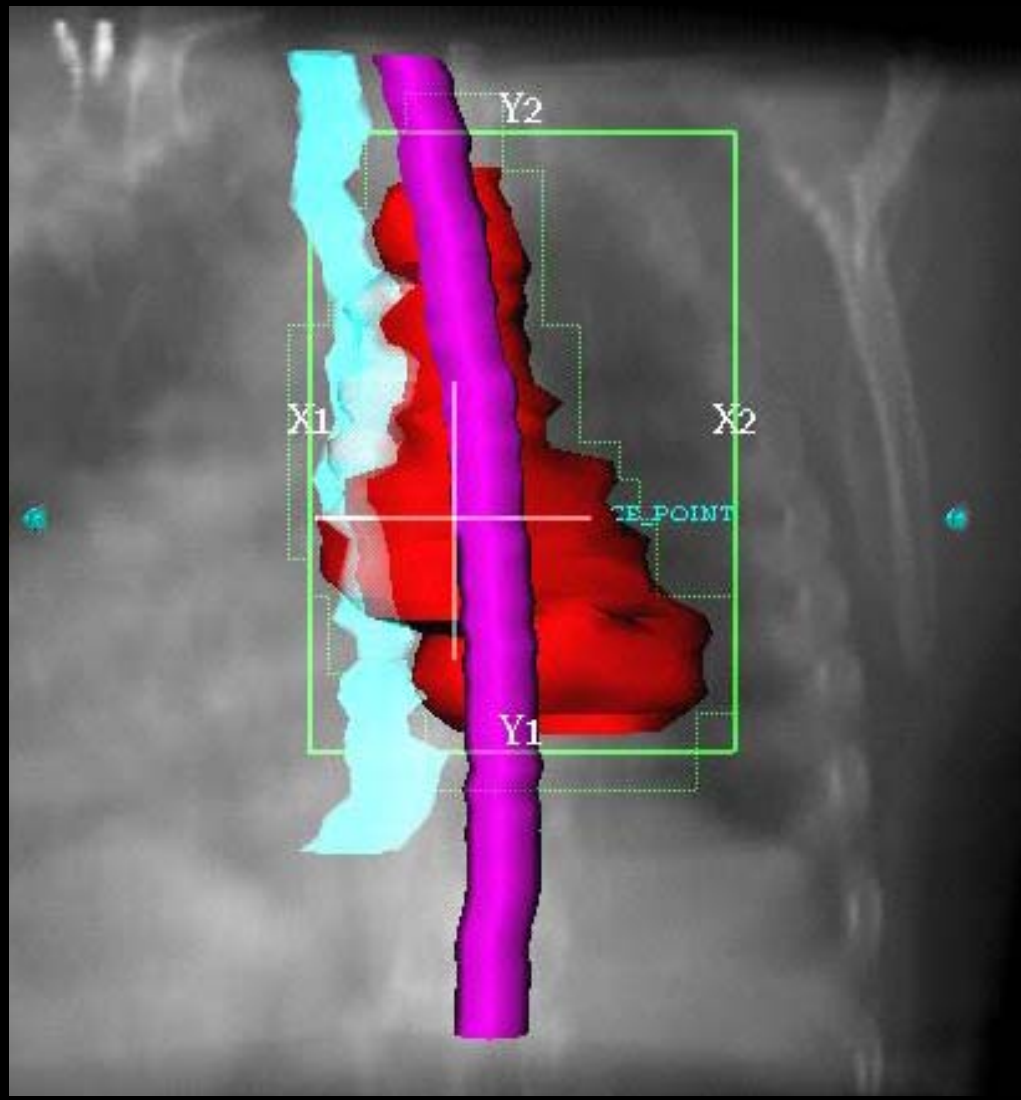
# Campo Obliquo 320°



# Campo Obliquo 140°

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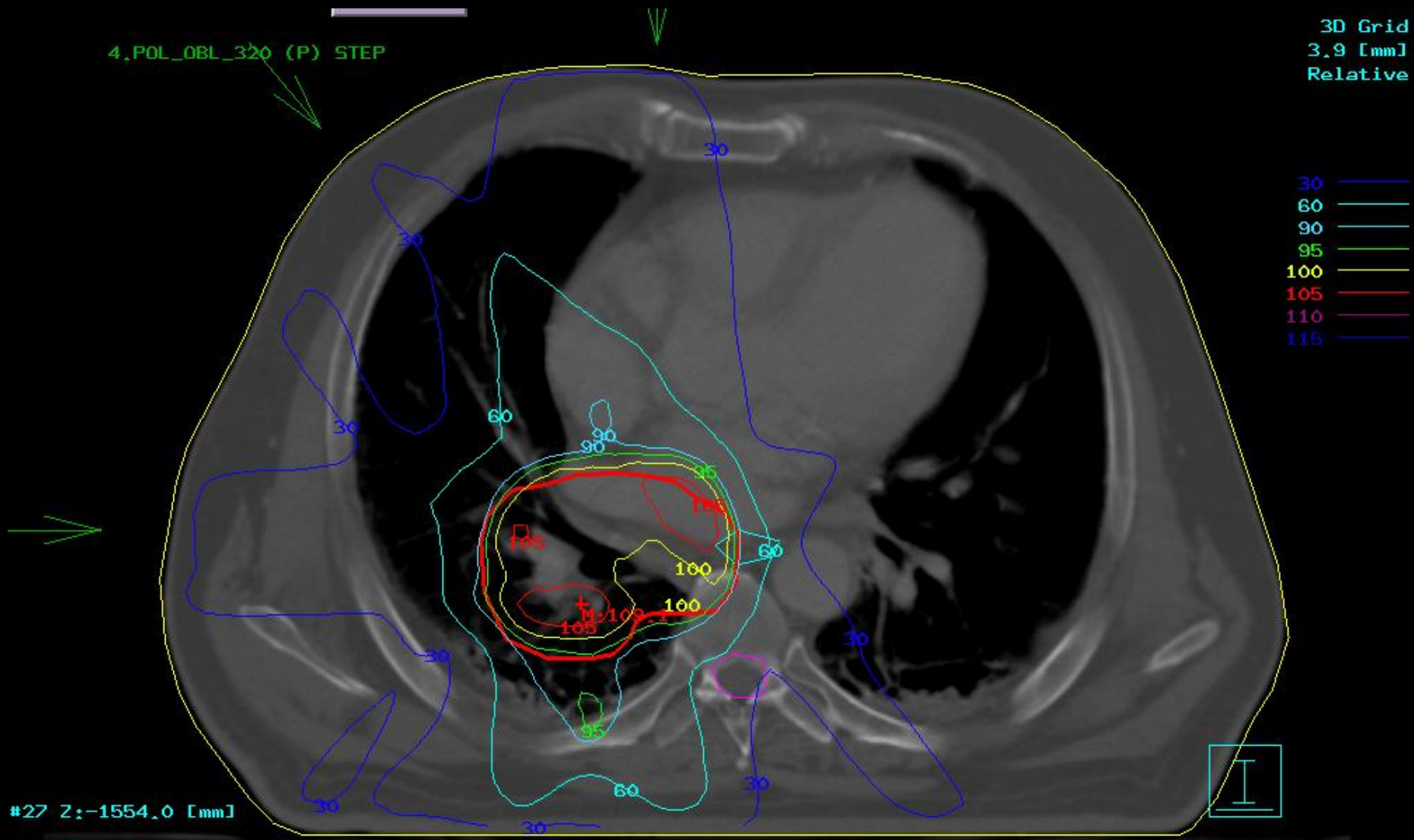
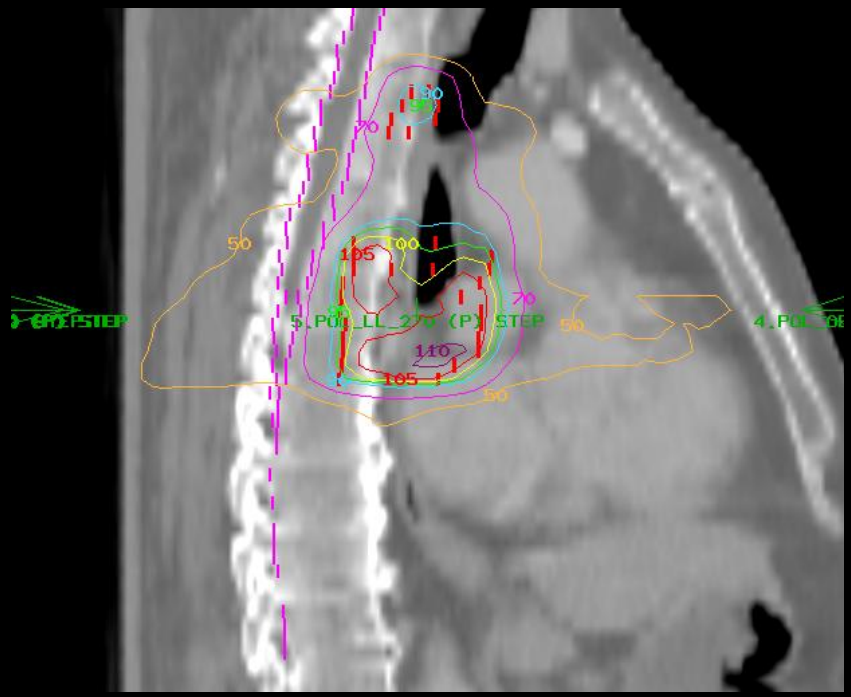
# Distribuzione di dose



# Distribuzione di dose




Sagittale

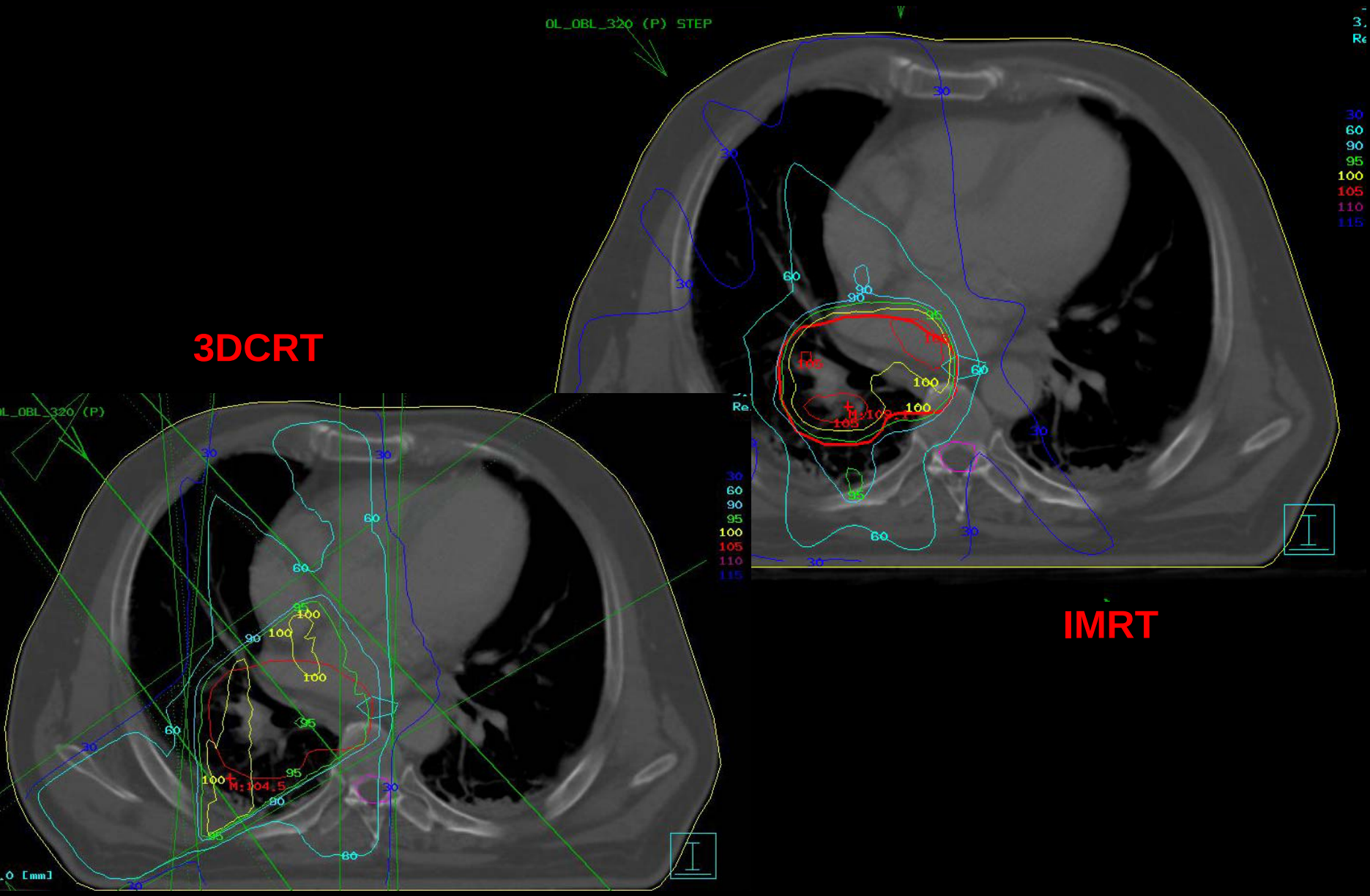
Coronale

# Piano di trattamento

| | | | | | | |
|---|---|---|---|---|---|---|
| LABEL | : Piano IMRT | | | | | |
| NORMALIZE | : Point # 1 | | | | | |
| PRESCRIBE | : 190.1cGy to 100% in 33 fraction(s) | | | | | |
| PLAN DATE | : | | | | | |
| Beam | 1 | 2 | 3 | 4 | 5 | 6 |
| Name | POL_AP_0 | POL_PA_180 | POL_OBL_240 | POL_OBL_320 | POL_LL_270 | POL_OBL_140 |
| Unit | Elekta | Elekta | Elekta | Elekta | Elekta | Elekta |
| X/E | 10X | 10X | 10X | 10X | 10X | 10X |
| | SAD | SAD | SAD | SAD | SAD | SAD |
| SSD | 84.9 | 89.1 | 85.8 | 83.6 | 82.4 | 85.9 |
| Depth | 15.1 | 10.9 | 14.2 | 16.4 | 17.6 | 14.1 |
| Angle | 0.0 | 180.0 | 220.0 | 320.0 | 270.0 | 140.0 |
| Start | - | - | - | - | - | - |
| Stop | - | - | - | - | - | - |
| PCT | Asym FX | Asym FX | Asym FX | Asym FX | Asym FX | Asym FX |
| | Asym FY | Asym FY | Asym FY | Asym FY | Asym FY | Asym FY |
| FX | 10.0 | 10.5 | 9.5 | 11.0 | 8.0 | 11.0 |
| FEX1 | -6.8 | -3.2 | -3.8 | -7.2 | -4.2 | -3.8 |
| FEX2 | 3.2 | 7.2 | 5.8 | 3.8 | 3.8 | 7.2 |
| FY | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 |
| FEY1 | -6.0 | -6.0 | -6.0 | -6.0 | -6.0 | -6.0 |
| FEY2 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| SCT | ITP | ITP | ITP | ITP | ITP | ITP |
| Angle | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| X | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Y | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Z | 14.9 | 14.9 | 14.9 | 14.9 | 14.9 | 14.9 |
| Angle | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Wedge | None | None | None | None | None | None |
| Angle | - | - | - | - | - | - |
| Name | - | - | - | - | - | - |
| Block | None | None | None | None | None | None |
| Tray | None | None | None | None | None | None |
| | - | - | - | - | - | - |
| Correc tions | Inhomog. *ON* Bolus *OFF* | Inhomog. *ON* Bolus *OFF* | Inhomog. *ON* Bolus *OFF* | Inhomog. *ON* Bolus *OFF* | Inhomog. *ON* Bolus *OFF* | Inhomog. *ON Bolus *OFF |
| Weight | 0.334 | 0.325 | 0.373 | 0.231 | 0.405 | 0.232 |
| MU/Min | 257.9 | 126.8 | 286.4 | 238.4 | 123.8 | 280.1 |
| wedge | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| open | 257.9 | 126.8 | 286.4 | 238.4 | 123.8 | 280.1 |

| | | | | | | |
|---|---|---|---|---|---|---|
| LABEL | : Piano IMRT | | | | | |
| NORMALIZE | : Point # 1 | | | | | |
| PRESCRIBE | : 190.1cGy to 100% in 33 fraction(s) | | | | | |
| PLAN DATE | : | | | | | |
| Normalisation Point X | Y | Z | RTS dose cGy | ITP dose cGy | 1 - ITP/RTS * 100% | |
| -1.4 | 6.4 | -152.9 | 190.1 | 200.0 | -5.2 | |
| Beam | 1 | 2 | 3 | 4 | 5 | 6 |
| Name | POL_AP_0 | POL_PA_180 | POL_OBL_240 | POL_OBL_320 | POL_LL_270 | POL_OBL_140 |
| | | | | | MU data | |
| Total | 257.9 | 126.8 | 286.4 | 238.4 | 123.8 | 280.1 |
| Seg:MU | 1 : 6.7 | 1 : 6.1 | 1 : 8.3 | 1 : 10.3 | 1 : 8.3 | 1 : 6.4 |
| Seg:MU | 2 : 7.0 | 2 : 6.0 | 2 : 8.6 | 2 : 5.0 | 2 : 8.2 | 2 : 6.2 |
| Seg:MU | 3 : 6.7 | 3 : 6.1 | 3 : 8.3 | 3 : 5.0 | 3 : 8.3 | 3 : 6.4 |
| Seg:MU | 4 : 6.7 | 4 : 6.0 | 4 : 8.6 | 4 : 5.0 | 4 : 8.3 | 4 : 6.4 |
| Seg:MU | 5 : 7.0 | 5 : 6.1 | 5 : 8.3 | 5 : 5.2 | 5 : 8.2 | 5 : 6.4 |
| Seg:MU | 6 : 6.7 | 6 : 6.1 | 6 : 8.3 | 6 : 5.0 | 6 : 8.3 | 6 : 6.2 |
| Seg:MU | 7 : 6.7 | 7 : 6.0 | 7 : 8.6 | 7 : 5.0 | 7 : 8.3 | 7 : 6.4 |
| Seg:MU | 8 : 7.0 | 8 : 6.1 | 8 : 25.2 | 8 : 5.0 | 8 : 8.2 | 8 : 6.4 |
| Seg:MU | 9 : 6.7 | 9 : 6.1 | 9 : 8.6 | 9 : 5.2 | 9 : 8.3 | 9 : 6.4 |
| Seg:MU | 10 : 6.7 | 10 : 6.0 | 10 : 8.3 | 10 : 5.0 | 10 : 8.3 | 10 : 6.2 |
| Seg:MU | 11 : 6.7 | 11 : 6.1 | 11 : 33.8 | 11 : 15.3 | 11 : 8.2 | 11 : 6.4 |
| Seg:MU | 12 : 7.0 | 12 : 6.0 | 12 : 8.3 | 12 : 5.0 | 12 : 8.3 | 12 : 6.4 |
| Seg:MU | 13 : 6.7 | 13 : 6.1 | 13 : 8.3 | 13 : 5.0 | 13 : 8.3 | 13 : 6.2 |
| Seg:MU | 14 : 6.7 | 14 : 6.1 | 14 : 8.6 | 14 : 5.2 | 14 : 8.2 | 14 : 6.4 |
| Seg:MU | 15 : 7.0 | 15 : 6.0 | 15 : 8.3 | 15 : 5.0 | 15 : 8.3 | 15 : 6.4 |
| Seg:MU | 16 : 6.7 | 16 : 6.1 | 16 : 16.9 | 16 : 5.0 | | 16 : 6.4 |
| Seg:MU | 17 : 6.7 | 17 : 6.1 | 17 : 16.9 | 17 : 5.2 | | 17 : 19.0 |
| Seg:MU | 18 : 7.0 | 18 : 6.0 | 18 : 8.3 | 18 : 5.0 | | 18 : 6.4 |
| Seg:MU | 19 : 6.7 | 19 : 6.1 | 19 : 8.6 | 19 : 5.0 | | 19 : 6.2 |
| Seg:MU | 20 : 6.7 | 20 : 6.0 | 20 : 8.3 | 20 : 5.0 | | 20 : 6.4 |
| Seg:MU | 21 : 20.4 | 21 : 6.1 | 21 : 8.6 | 21 : 5.2 | | 21 : 6.4 |
| Seg:MU | 22 : 7.0 | | 22 : 8.3 | 22 : 5.0 | | 22 : 6.2 |
| Seg:MU | 23 : 6.7 | | 23 : 8.3 | 23 : 5.0 | | 23 : 12.9 |
| Seg:MU | 24 : 6.7 | | 24 : 8.6 | 24 : 5.0 | | 24 : 6.4 |
| Seg:MU | 25 : 7.0 | | 25 : 8.3 | 25 : 5.2 | | 25 : 6.2 |
| Seg:MU | 26 : 6.7 | | 26 : 8.6 | 26 : 5.0 | | 26 : 6.4 |
| Seg:MU | 27 : 6.7 | | 27 : 8.3 | 27 : 5.0 | | 27 : 6.4 |
| Seg:MU | 28 : 6.7 | | | 28 : 5.2 | | 28 : 6.4 |
| Seg:MU | 29 : 7.0 | | | 29 : 5.0 | | 29 : 6.2 |
| Seg:MU | 30 : 6.7 | | | 30 : 5.0 | | 30 : 6.4 |
| Seg:MU | 31 : 13.7 | | | 31 : 5.0 | | 31 : 6.4 |
| Seg:MU | 32 : 6.7 | | | 32 : 5.2 | | 32 : 6.2 |
| Seg:MU | 33 : 6.7 | | | 33 : 5.0 | | 33 : 6.4 |

# Confronto

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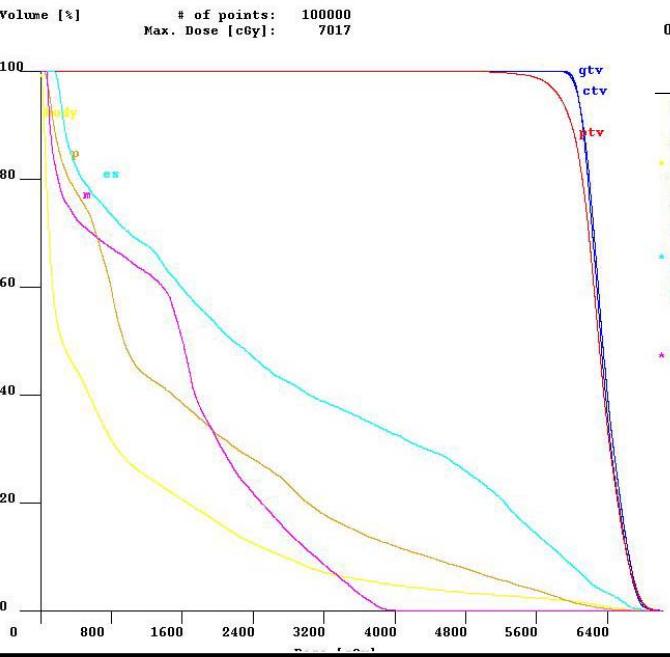
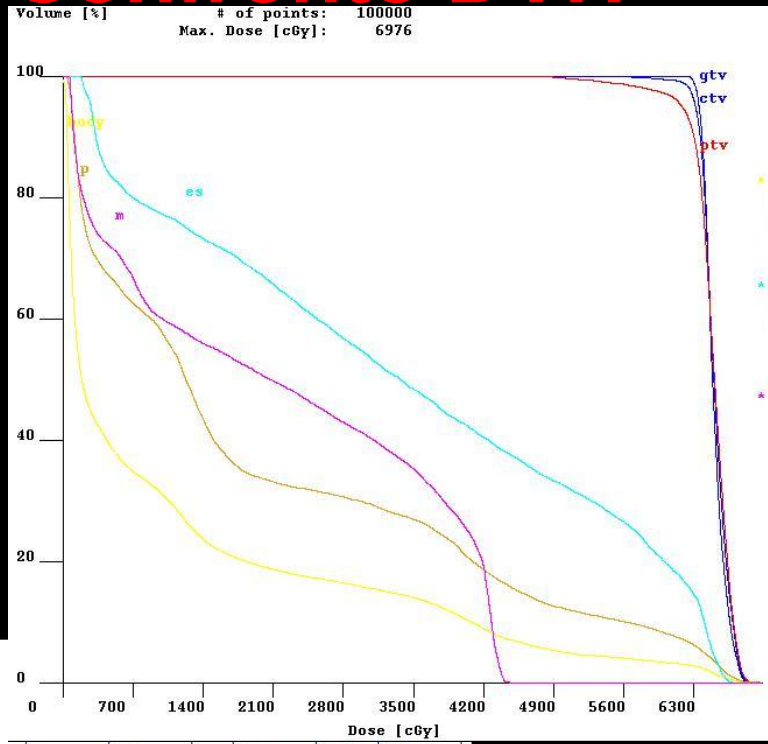
# Confronto DVH

## IMRT




| VOI | Vol. (cc) | Area (%) | Dose (cGy) Max | Min | Avg. |
|---|---|---|---|---|---|
| gtv | 123.1 | 93 | 6870 | 6067 | 6501 |
| ctv | 225.3 | 93 | 6915 | 5135 | 6505 |
| * body | 23372 | 15 | 6897 | 0 | 1114 |
| ptv | 376.7 | 92 | 6945 | 4574 | 6479 |
| p | 3253.8 | 28 | 6936 | 31 | 2007 |
| * es | 35.9 | 48 | 6676 | 176 | 3399 |
| m | 57.2 | 30 | 4455 | 65 | 2152 |

* (could be incomplete)

4455

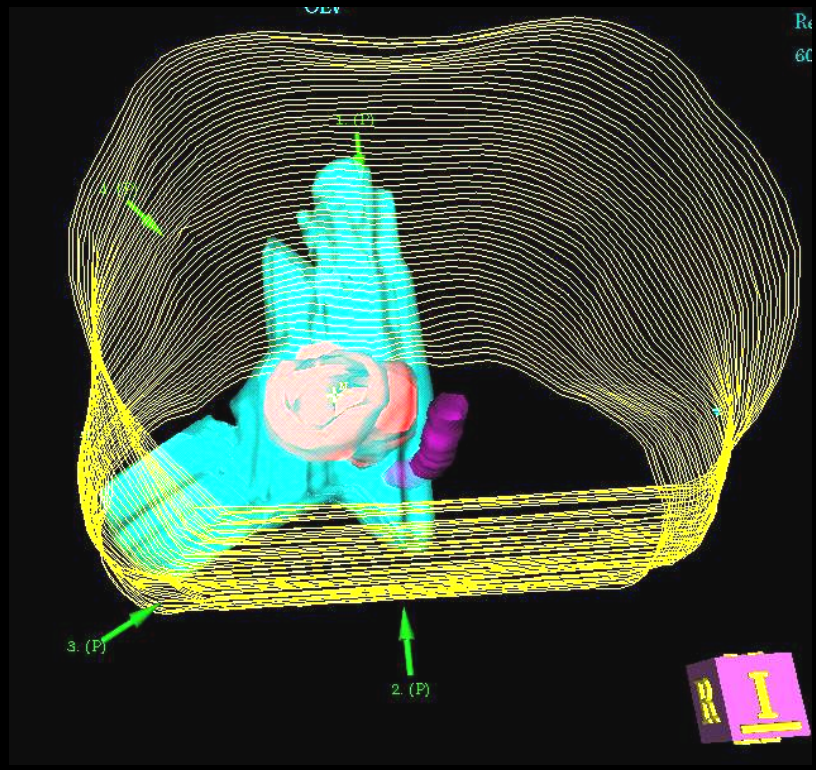
| | | | | | |
|---|---|---|---|---|---|
| gtv | 125.0 | 90 | 6970 | 5709 | 6349 |
| ctv | 222.8 | 90 | 6986 | 5367 | 6366 |
| * body | 23278 | 13 | 6867 | 0 | 917 |
| ptv | 375.2 | 89 | 6960 | 4564 | 6298 |
| p | 3256.3 | 24 | 6659 | 34 | 1694 |
| * es | 35.7 | 39 | 6825 | 0 | 2[illegible] |
| m | 57.1 | 11 | 4009 | 67 | 1511 |

* (could be incomplete)

4009

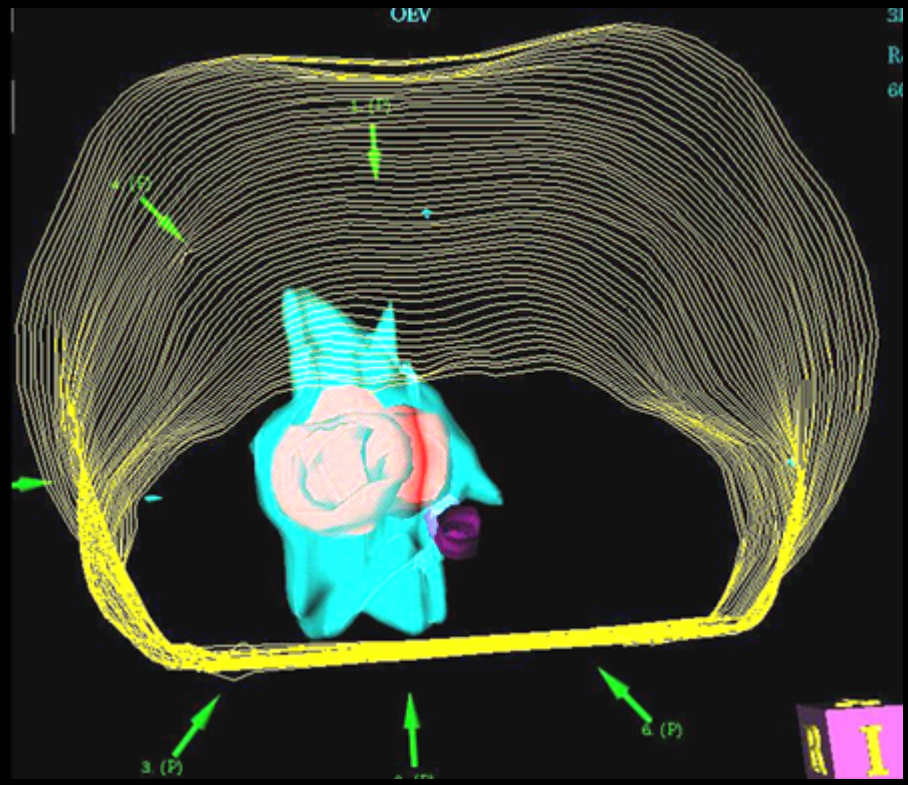
## 3DCRT

# Confronto OEV




3DCRT

IMRT



# Problematiche

- Ogni trattamento IMRT richiede una verifica dosimetrica specifica da parte del Fisico prima del trattamento ed in corso di trattamento;

- I sistemi di immobilizzazione devono avere una accuratezza maggiore (entro i 3 mm) rispetto ai trattamenti convenzionali visto che si lavora con elevati gradienti di dose;

- I tempi di pianificazione, di verifica e di trattamento sono elevati rispetto ad un trattamento conformazionale;

# Valutazione dei tempi

| | 3DCRT | IMRT |
|---|---|---|
| **Allineamento TC** | 20 min | 1 h |
| **Contornamento** | 45 min | 45 min – 1 h 30 min |
| **Piano di trattamento** | 1 – 2 h | 2 – 5 h |
| **Discussione piano** | 15 min | 1 h |
| **Stampa ed export** | 30 min | 1 h |
| **Verifica piano** | ----- | 1 – 3 h |
| **Verifica trattamento** | ----- | 1 – 3 h |
| **Verifica isocentro** | 5 – 10 min | 20 – 30 min |
| **Trattamento** | 10 – 15 min | 1 h |
| **Totale** | **2h 45 min – 3 h 55 min** | **9 h – 17 h*** |

**** Da includere 1 h per ogni verifica dosimetrica in corso di trattamento***

# Cenni bibliografici


- Vincent W.C. Wu, Dora L.W. Kwong, Jonathan S.T. Sham – **Target Dose conformity in 3-dimensional conformal radiotherapy and intensity modulated radiotherapy** – Radioterapy and Oncology 71 (2004) 201 - 206;
- Olivier Chapet, M.D., Emma Thomas, M.D., Marc L. Kessler, Ph. D., Benedick A. Fraass, Ph. D., and Randall K. Ten Haken, Ph. D. – **Esophagus sparing with IMRT lung tumor irradiation: an eud-based optimization technique** – Int. J. Radiation Oncology Biol. Phys., Vol 63, No. 1 pp 179-187, 2005;
- James A. Purdy, W. Grant III, J.R. Palta, E.B. Butler, and C.A. Perez – **3-D CONFORMAL AND INTENSITY MODULATED RADIATION THERAPY: PHYSICS & CLINICAL APLLICATIONS** – ADVANCED MEDICAL PUBLISHING, INC., 2001;
- Edward S. Sternick, Ph.D. – **The THEORY and PRACTICE of INTENSITY MODULATED RADIATION THERAPY** – ADVANCED MEDICAL PUBLISHING, INC., 1997;


*Grazie*