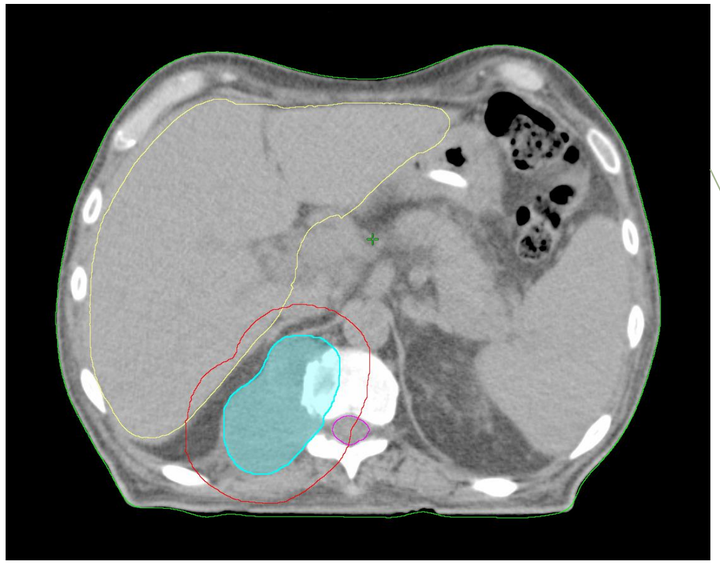
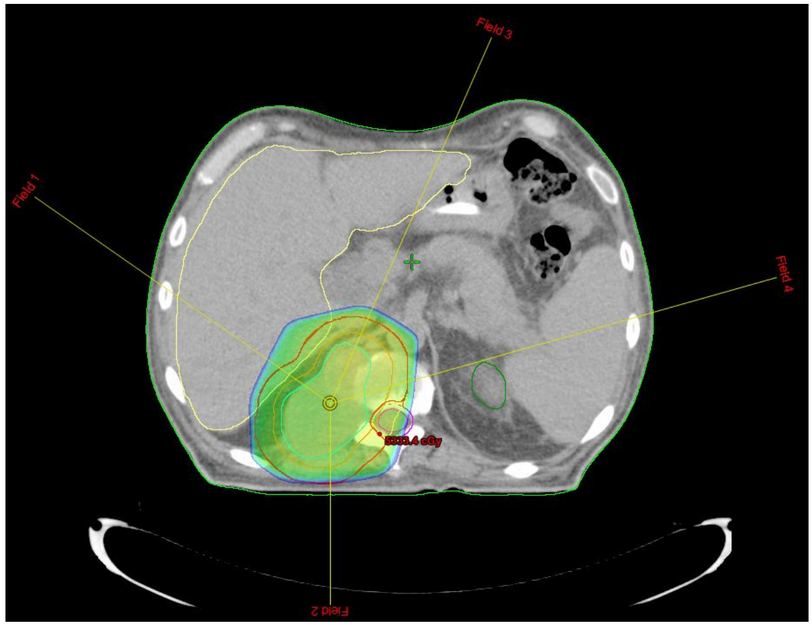
IGRT ï Visão Geral

Marília Becker Lima
Física Médica

SIMULAÇÃO





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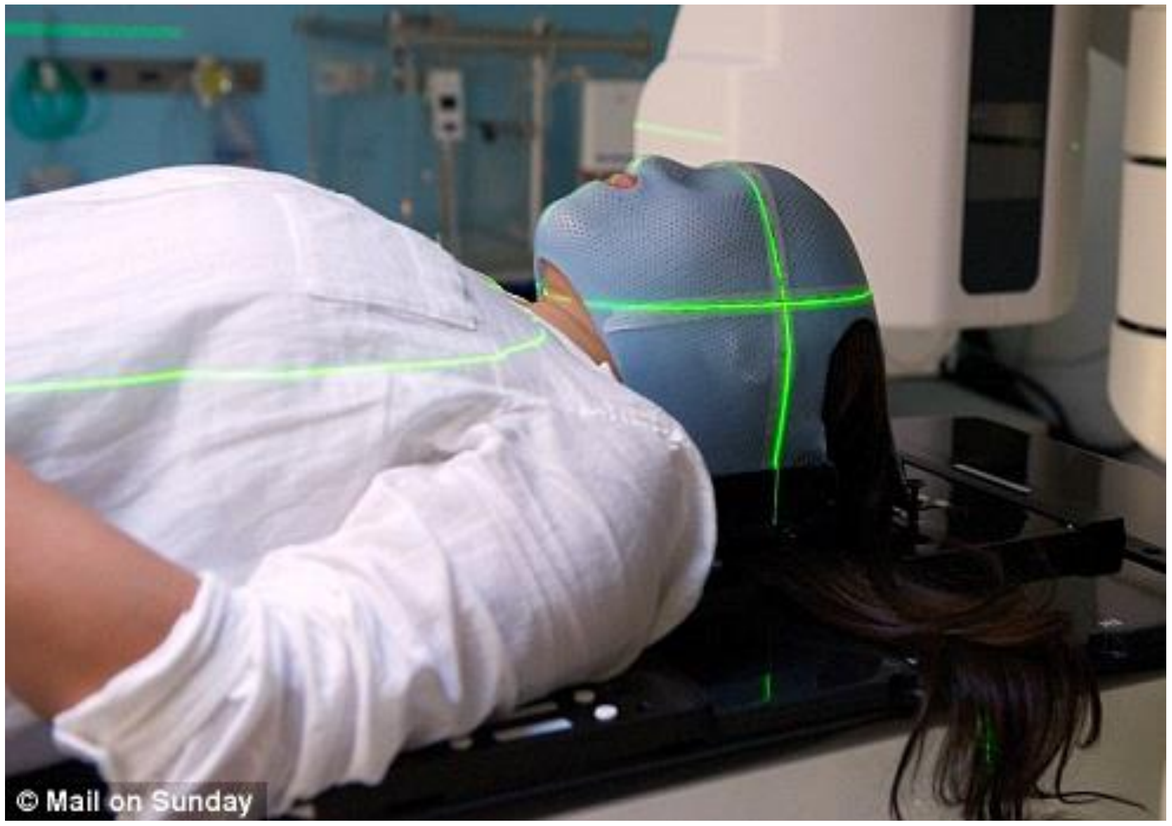
TRATAMENTO



TRATAMENTO CONVENCIONAL

IGRT

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IGRT - Definição

IGRT. The Radiation Therapy Oncology Group (RTOG) research plan of 2002–2006 defines IGRT as referring broadly to "treatment delivery using modern imaging methods, such as computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), and ultrasound, in target and non-target structures and in RT definition, design and delivery. . . ." The authors

RTOG®
RADIATION THERAPY ONCOLOGY GROUP

IGRT (Image Guided Radiotherapy)

Image guided radiotherapy (IGRT) provides high-resolution, three-dimensional images to pinpoint tumor sites, adjust patient positioning when necessary, and complete a treatment—all within the standard treatment time slot. These capabilities take IMRT and stereotactic IMRT technologies one step further by raising the quality of patient care and improving efficiency. IGRT technology accounts for motion to ensure that the target is in the same position every treatment session. With IGRT, innovative radiographic, fluoroscopic and cone-beam CT modes are integrated with automated repositioning and motion management visualization software. This enables clinicians to verify that treatments are completely in sync with respiration.

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IGRT - Definição

ATC • AdvancedTechnologyConsortium
Providing support in quality assurance and data management for radiation therapy clinical trials

Image Guided Radiation Therapy Guidelines:
ATC QA subcommittee report
October 18, 2009

Image guided radiation therapy (IGRT) is defined by this subcommittee as external beam radiation therapy with positional verification using imaging prior to each treatment fraction. Some imaging procedures can result in an additional significant dose to the patient, and are specifically excluded from consideration in these guidelines. For example, radiographic imaging each day of treatment is not considered to be an acceptable IGRT procedure. The definition of IGRT for this guideline is for a complete process that extends from the step of imaging a patient at the time of CT-simulation through the step of imaging the patient again at the treatment unit. This process includes the

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Modalidades de imagens

- **Equipamentos e técnicas**
  - Portal Imaging – iView
  - Energia MV

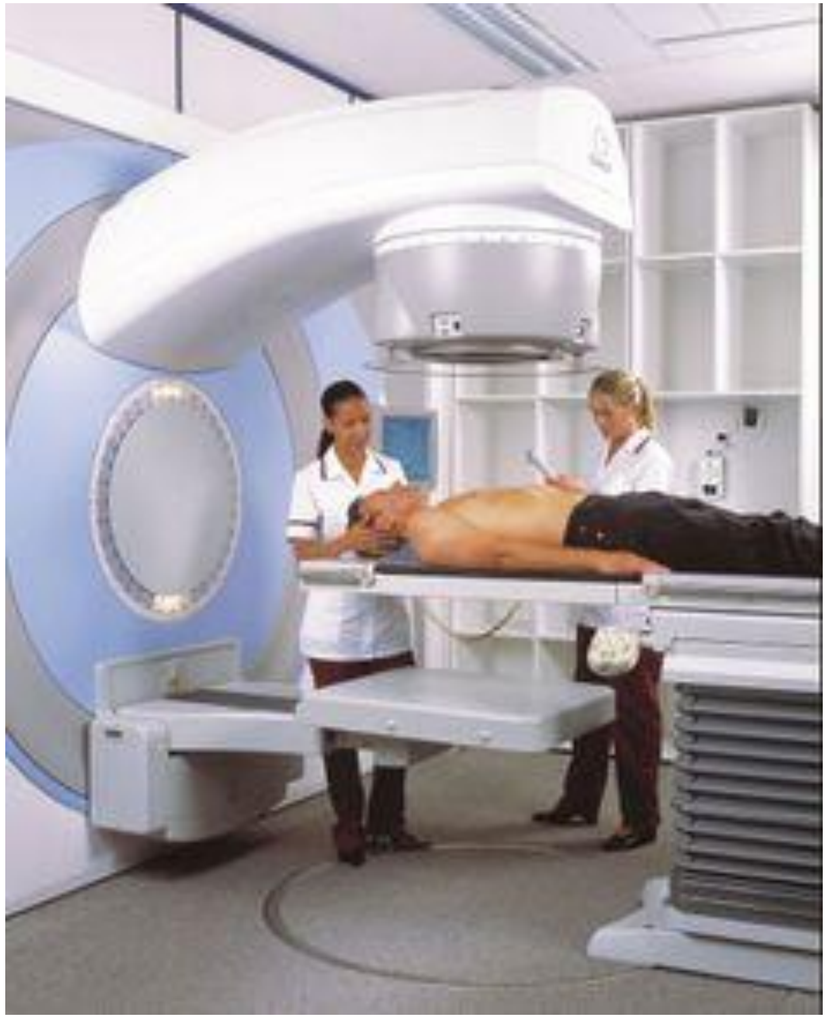

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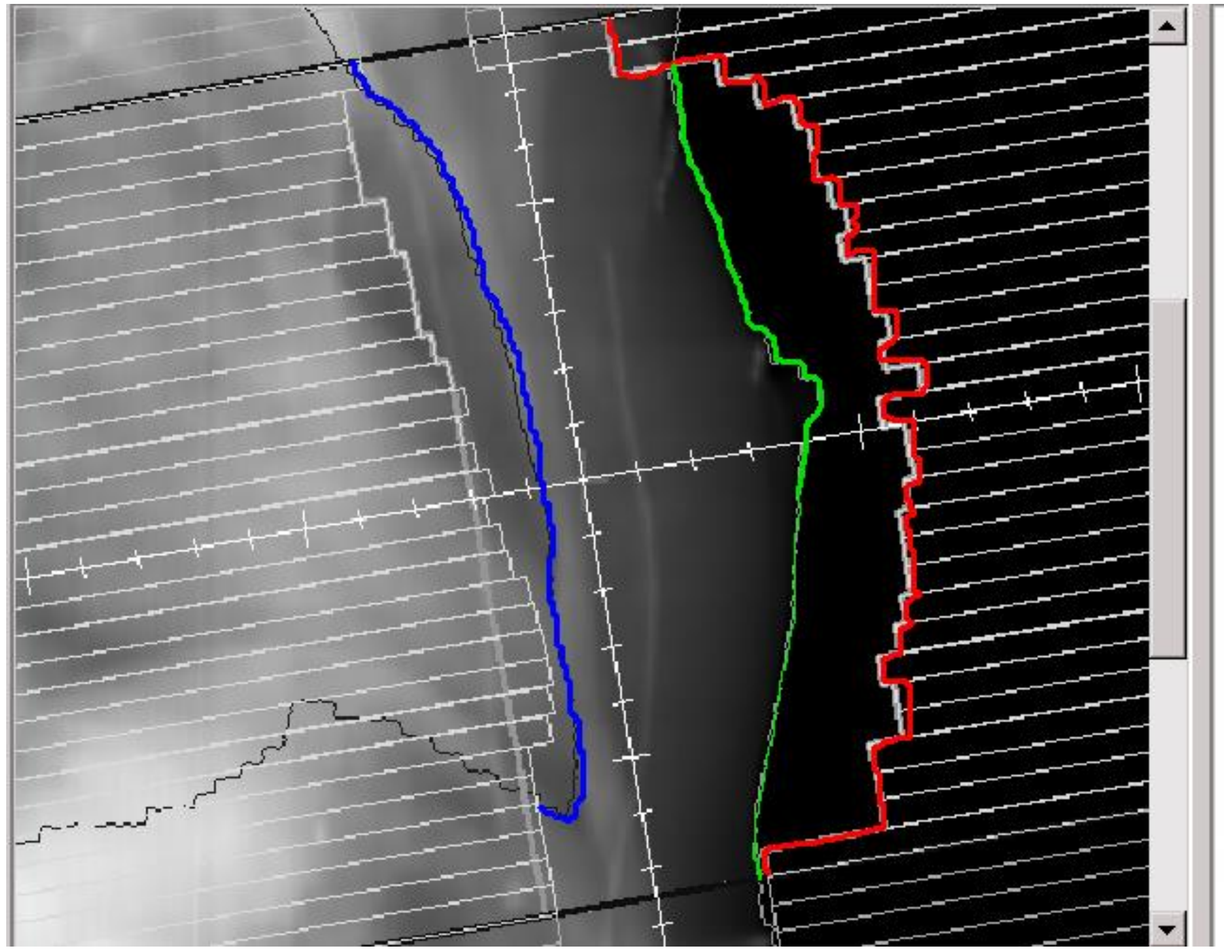
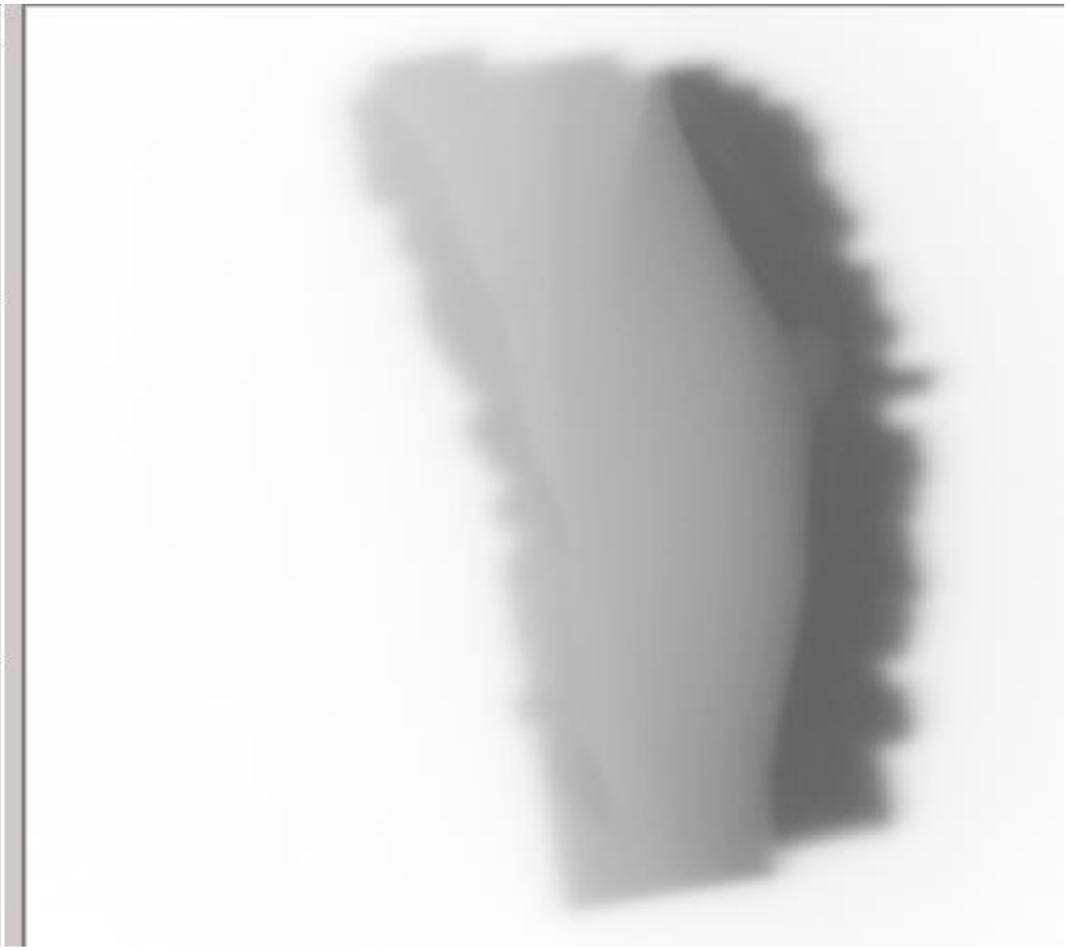
Imagem - EPID





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Modalidades de imagens

- **Equipamentos e técnicas**

kV

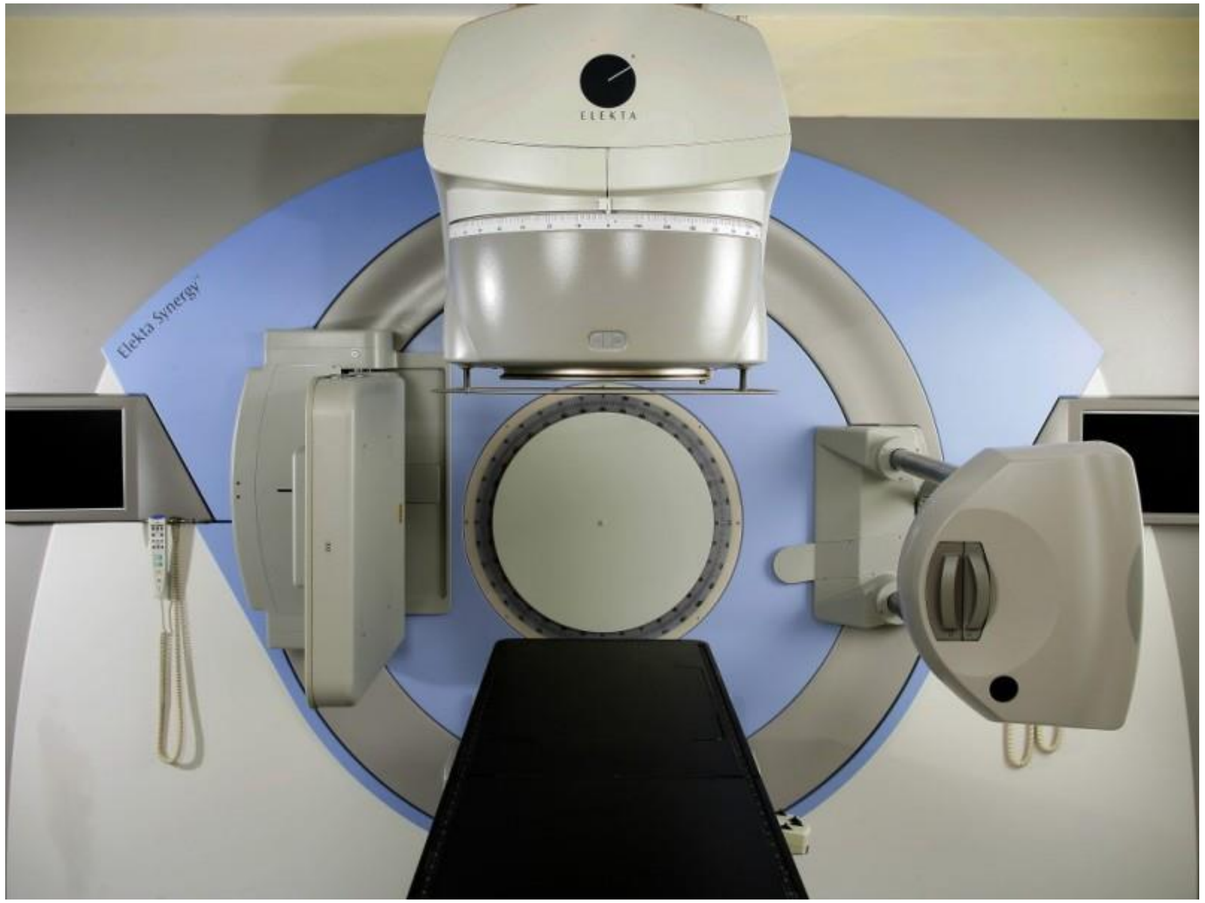

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Imagem kV

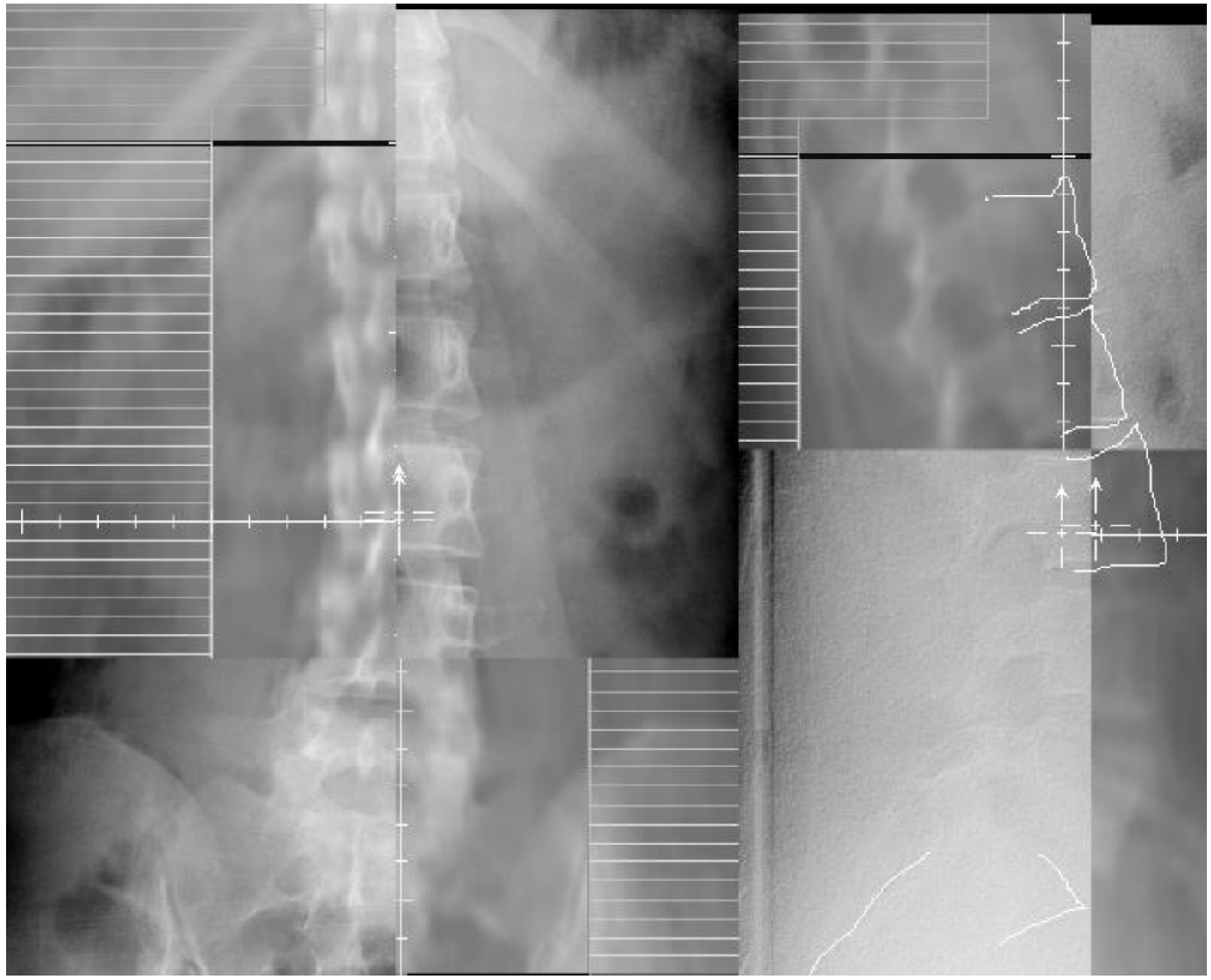

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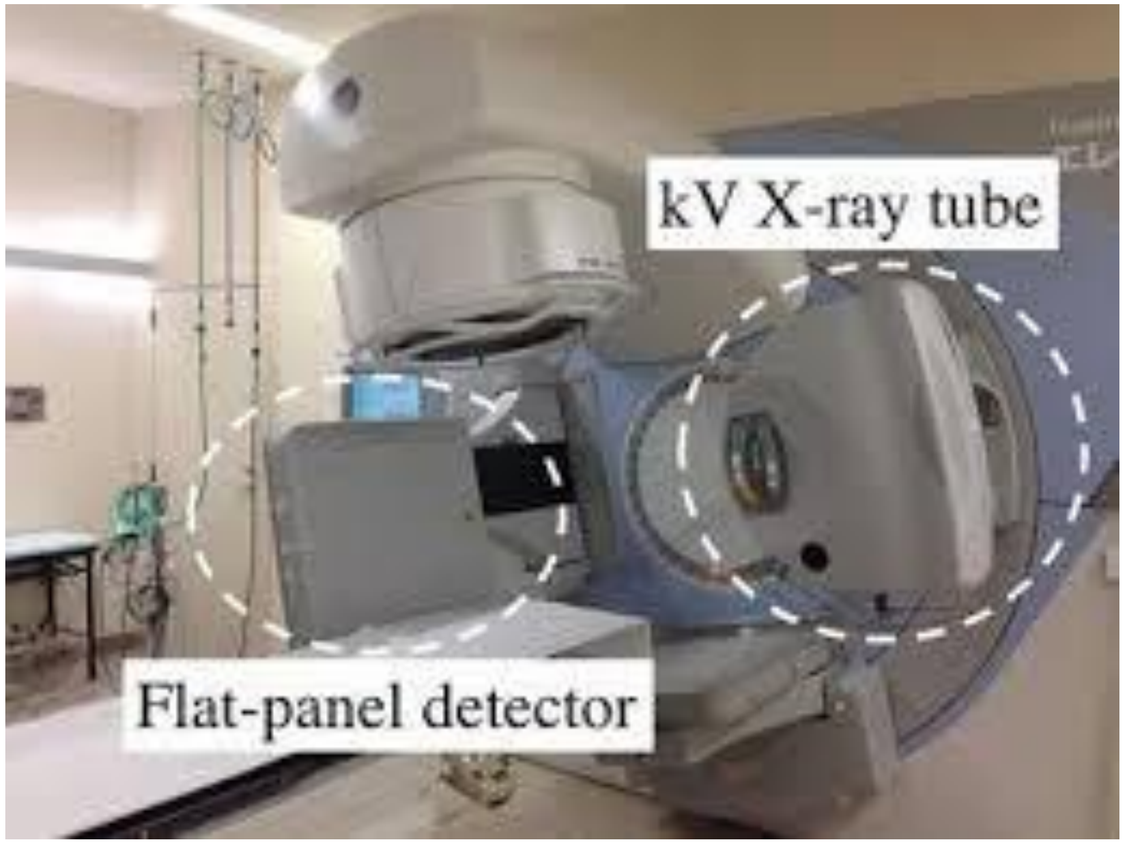
Imagem – CBCT



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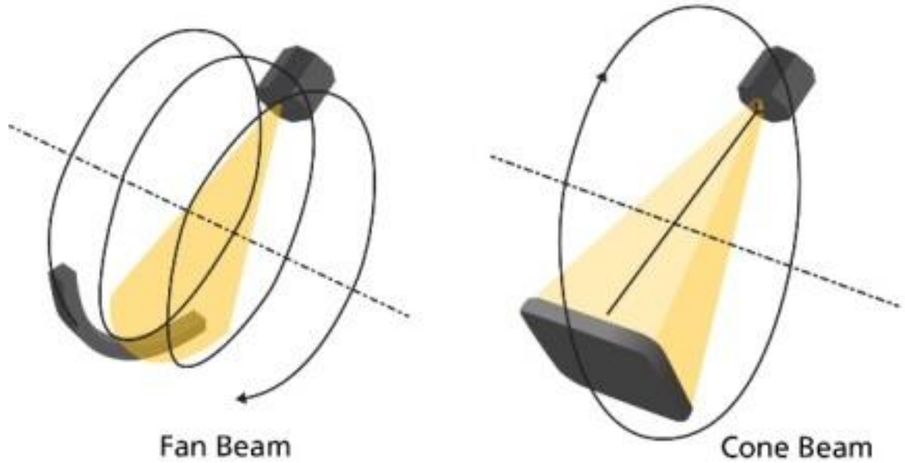
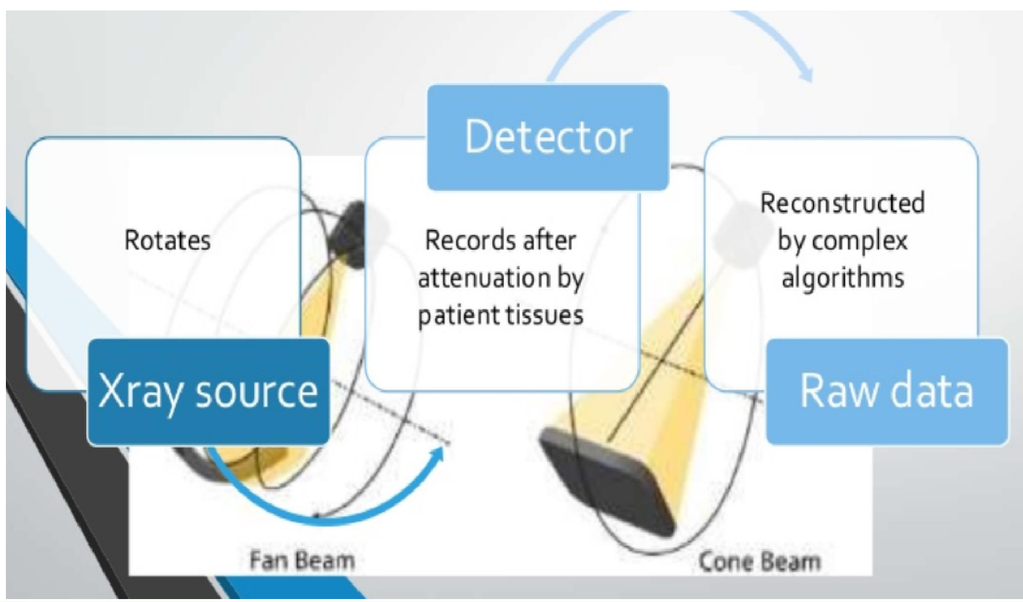
Aquisição CBCT





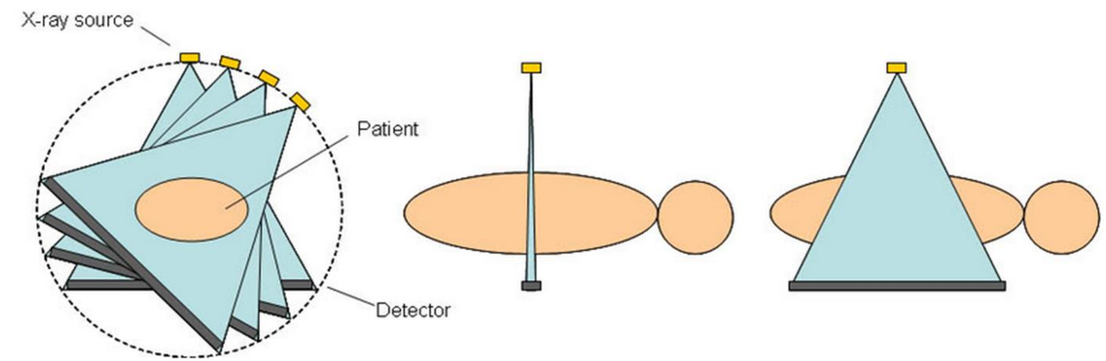


Figure 1. Computed Tomography scan versus Cone Beam Computed Tomography.

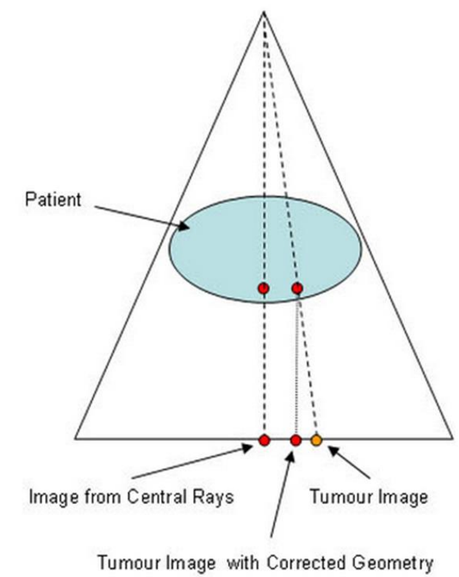


Figure 2. Geometry correction for cone beam.

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CBCT – KV

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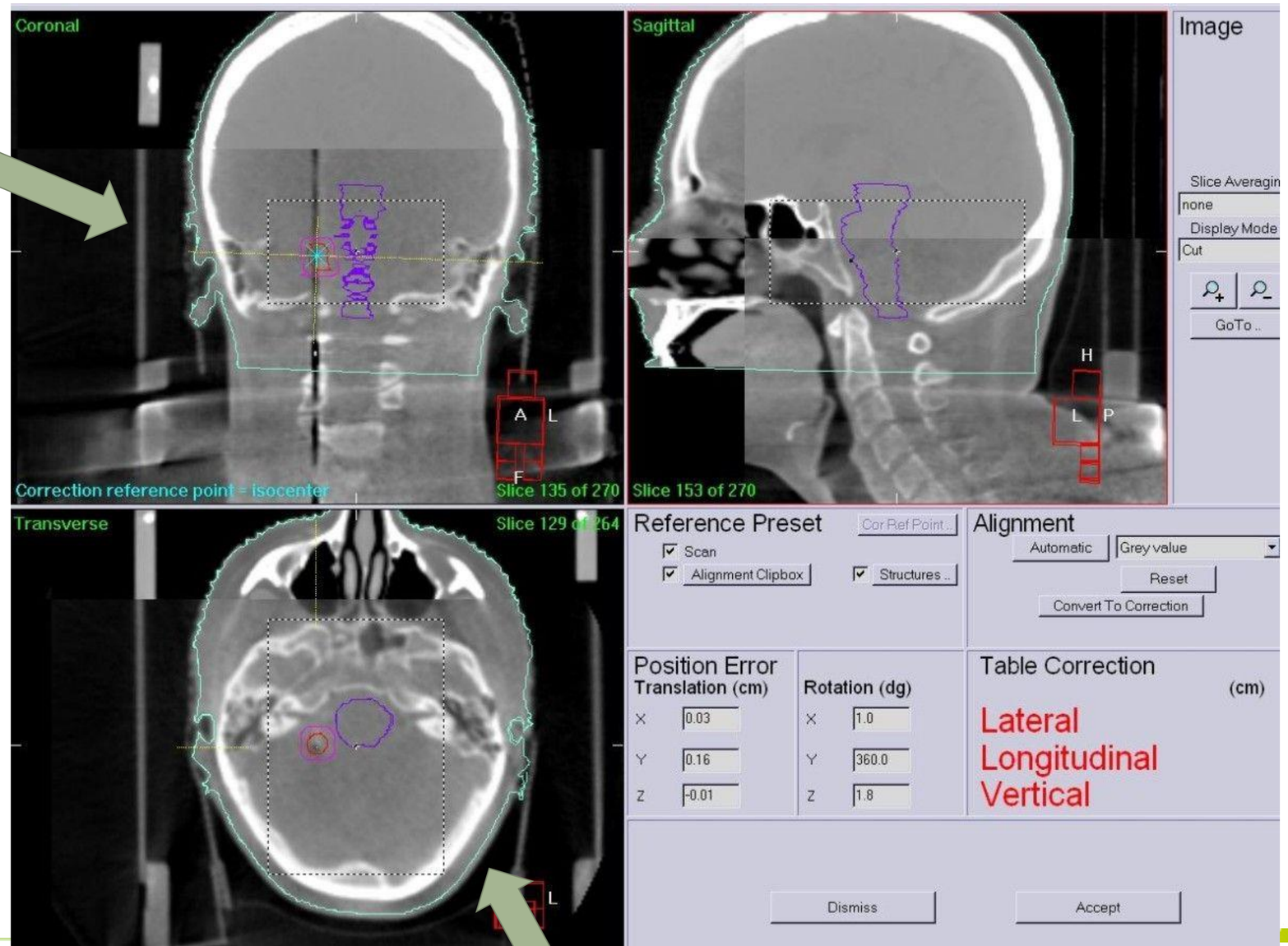
Imagem – CBCT

Cone Beam



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Porque Fazer IGRT?

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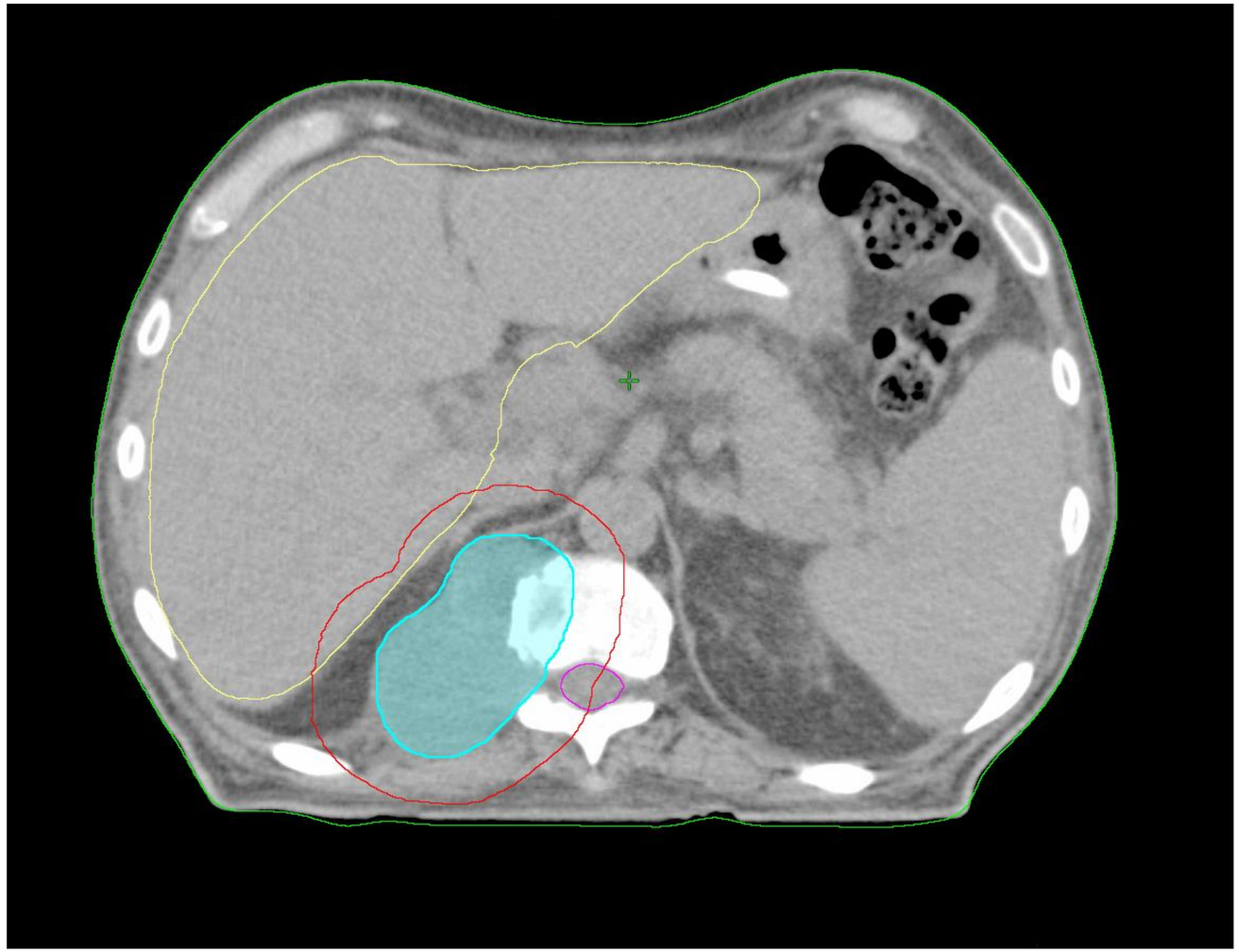
C2 and P1 - Restricted Information and Basic Personal Data

Evolução da Radioterapia



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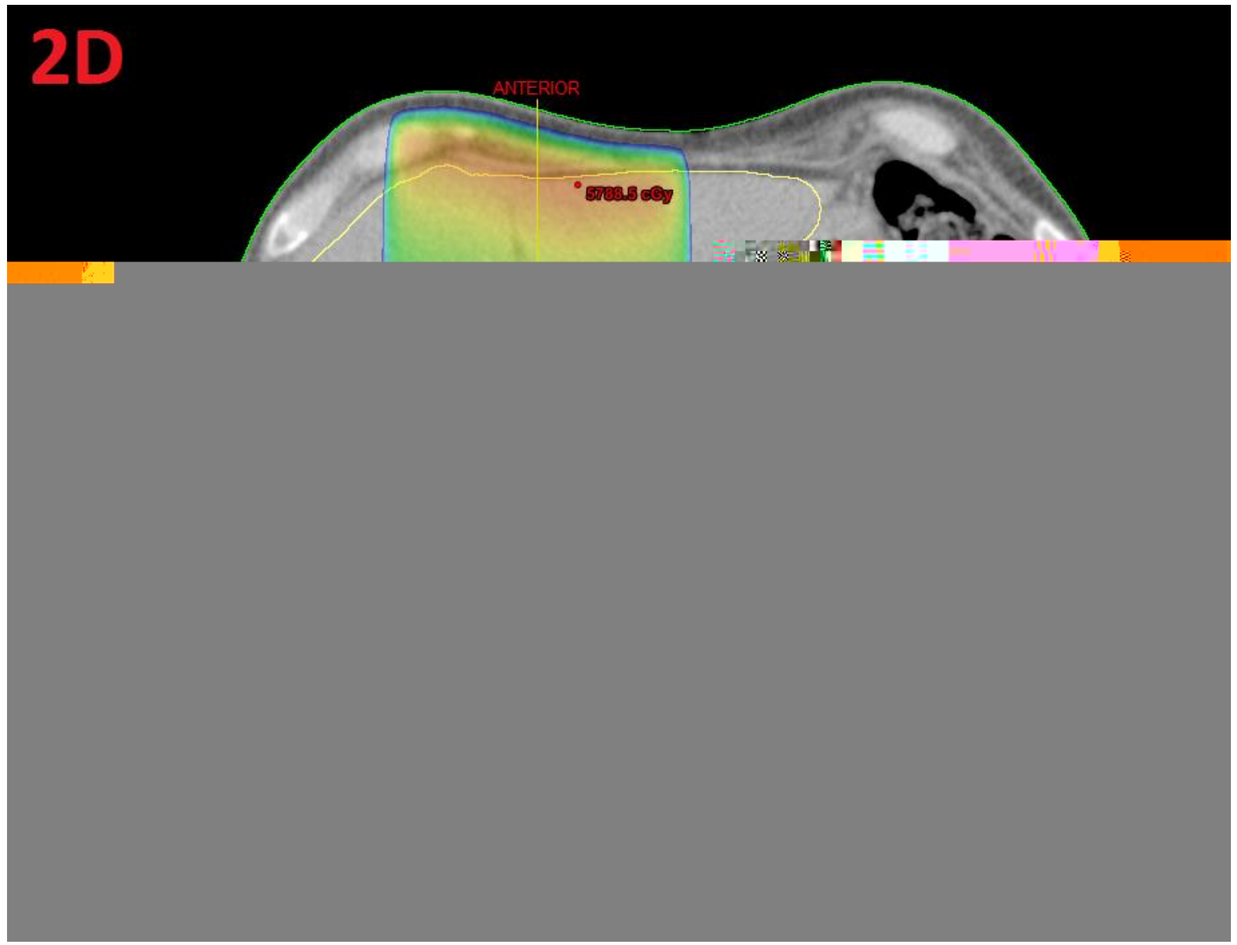
Evolução da Radioterapia



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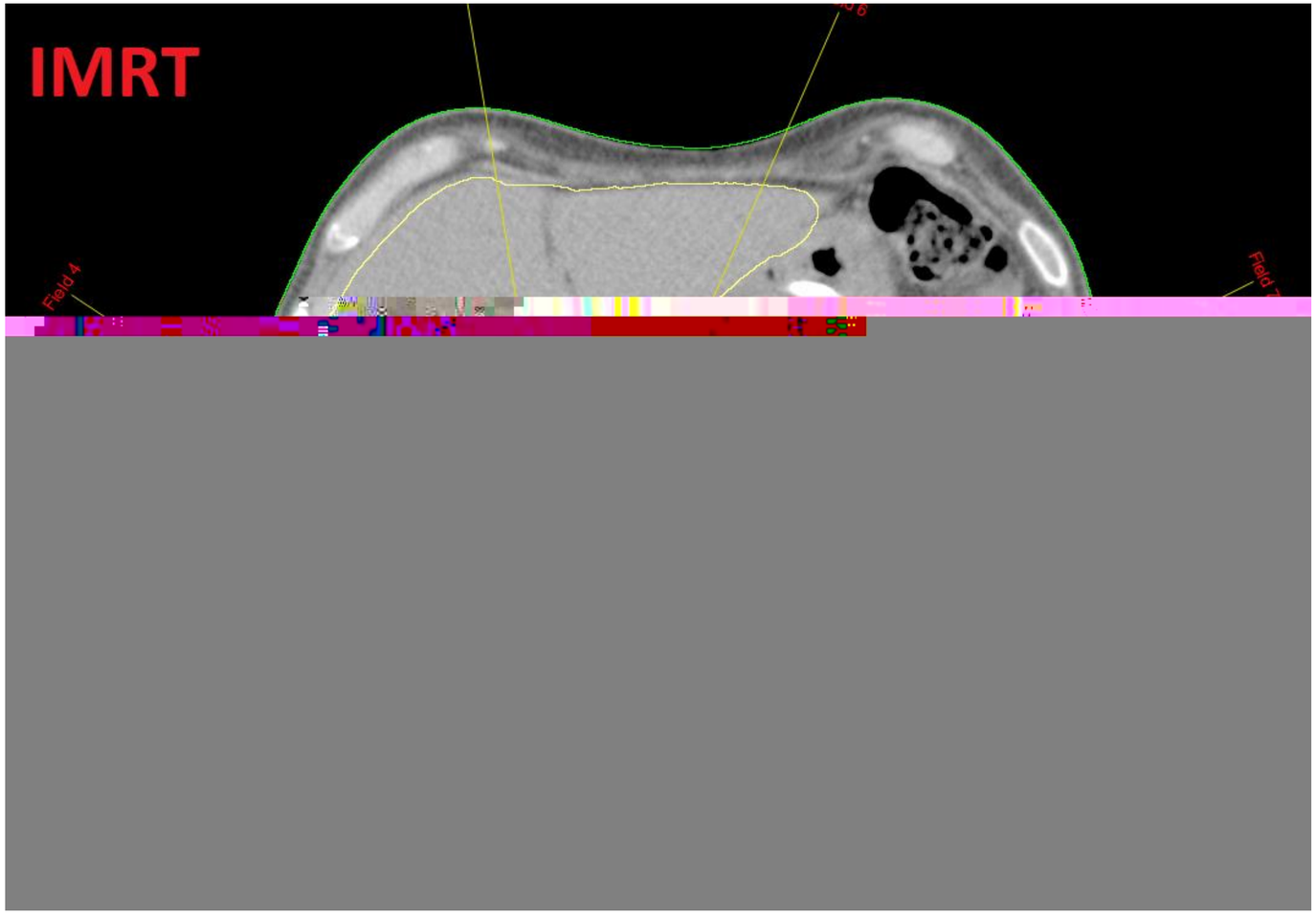
Evolução da Radioterapia



IGRT

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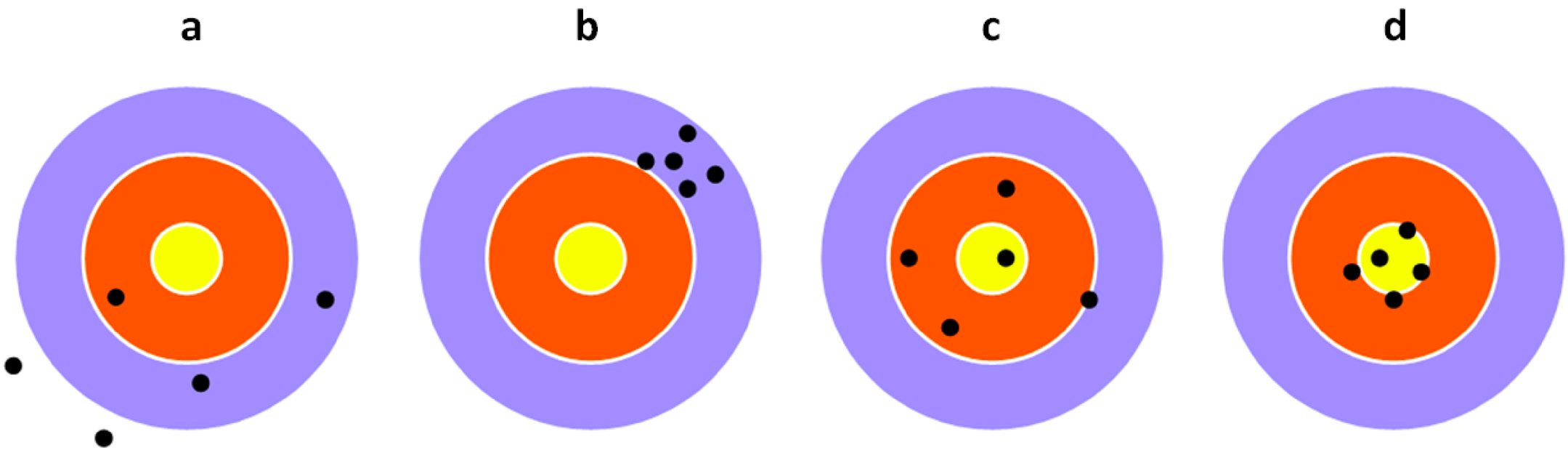
IGRT = Precisão + Exatidão



a	b	c	d
PRECISÃO: NÃO	**PRECISÃO:** SIM	**PRECISÃO:** NÃO	**PRECISÃO:** SIM
EXATIDÃO: NÃO	**EXATIDÃO:** NÃO	**EXATIDÃO:** SIM	**EXATIDÃO:** SIM

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C2 and P1 - Restricted Information and Basic Personal Data

Erros

- **Erros sistemáticos:**

  Desvios que acontecem na mesma direção e na mesma magnitude em cada fração do tratamento

Erro Sistemático

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Erros

- **Erros sistemáticos**
  - Desenho do ALVO

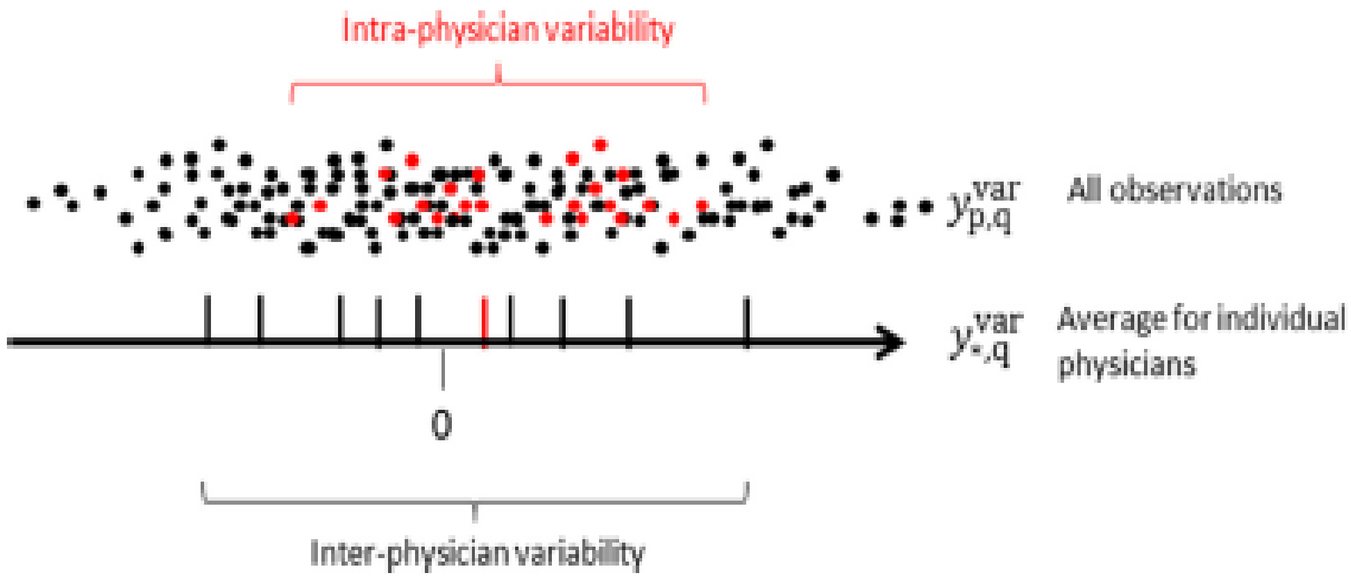
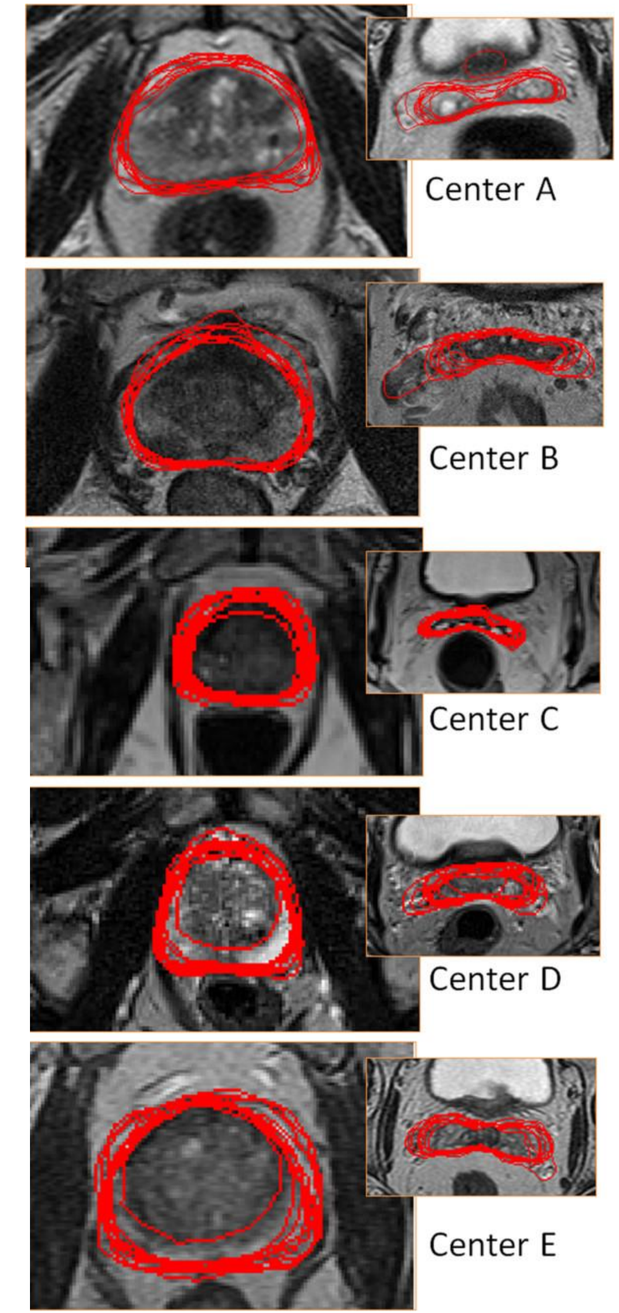


Figure 2 Illustration of the separation of the overall variability into inter- and intra-physician components. The red dots represent observations by an individual physician for the 25 patients. The red line indicate the average observation for the physician.



Nyholm et al. Radiation Oncology 2013, 8:126

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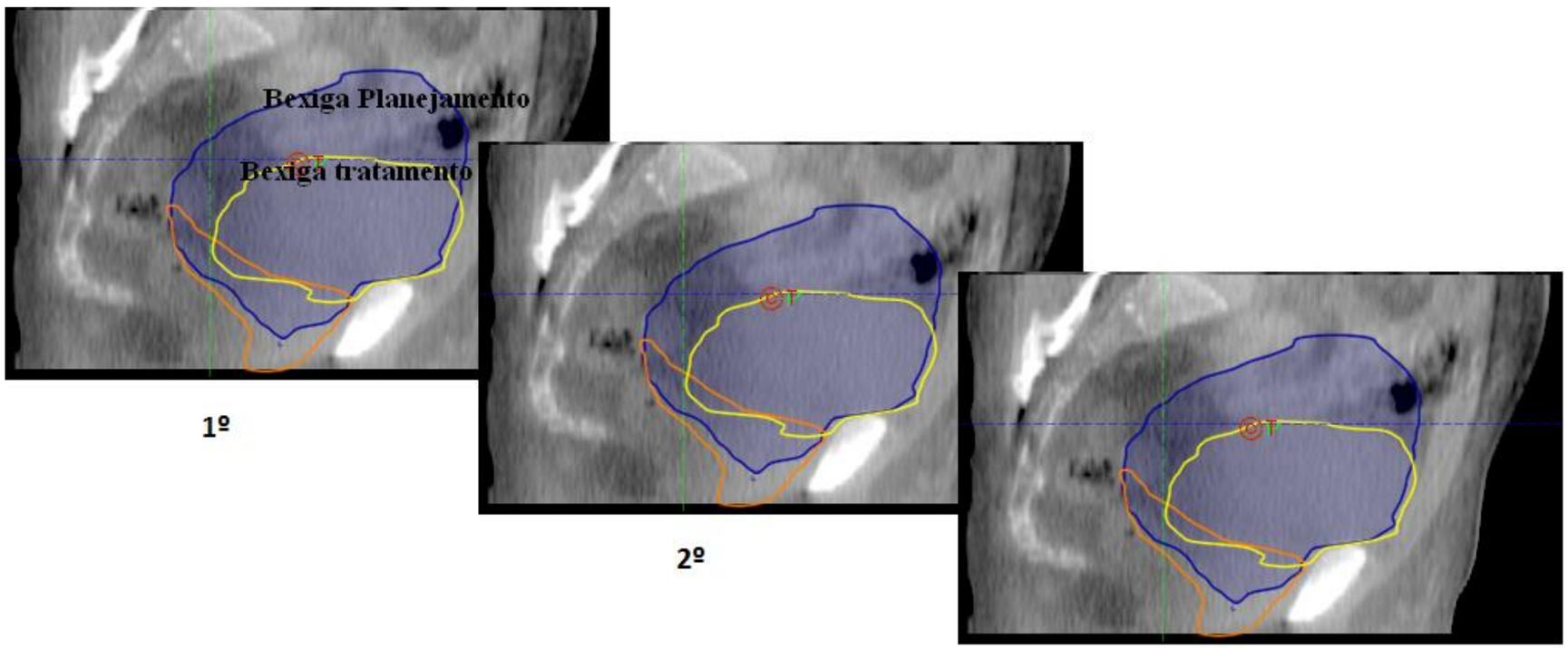
Erros

- **Erros sistemáticos**
  - Forma e posicionamento

  (entre a imagen do planejamento e o tratamento)

Erro Sistemático



1º

2º

3º

NOVA TC

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Erros

- **Erros sistemáticos**

  - Erro de transferência
    - Diferença no alinhamento do laser
    - Calibração dos movimentos da mesa de tratamento;
    - Posição do MLC
    - Angulo do gantry e colimador

Programa de QA do acelerador e tomógrafo

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Erros

- **Erros aleatórios:**

  Desvios que podem ocorrer em qualquer direção e magnitude para cada fração do tratamento.

Erro Randômico

C2 and P1 - Restricted Information and Basic Personal Data

Erros

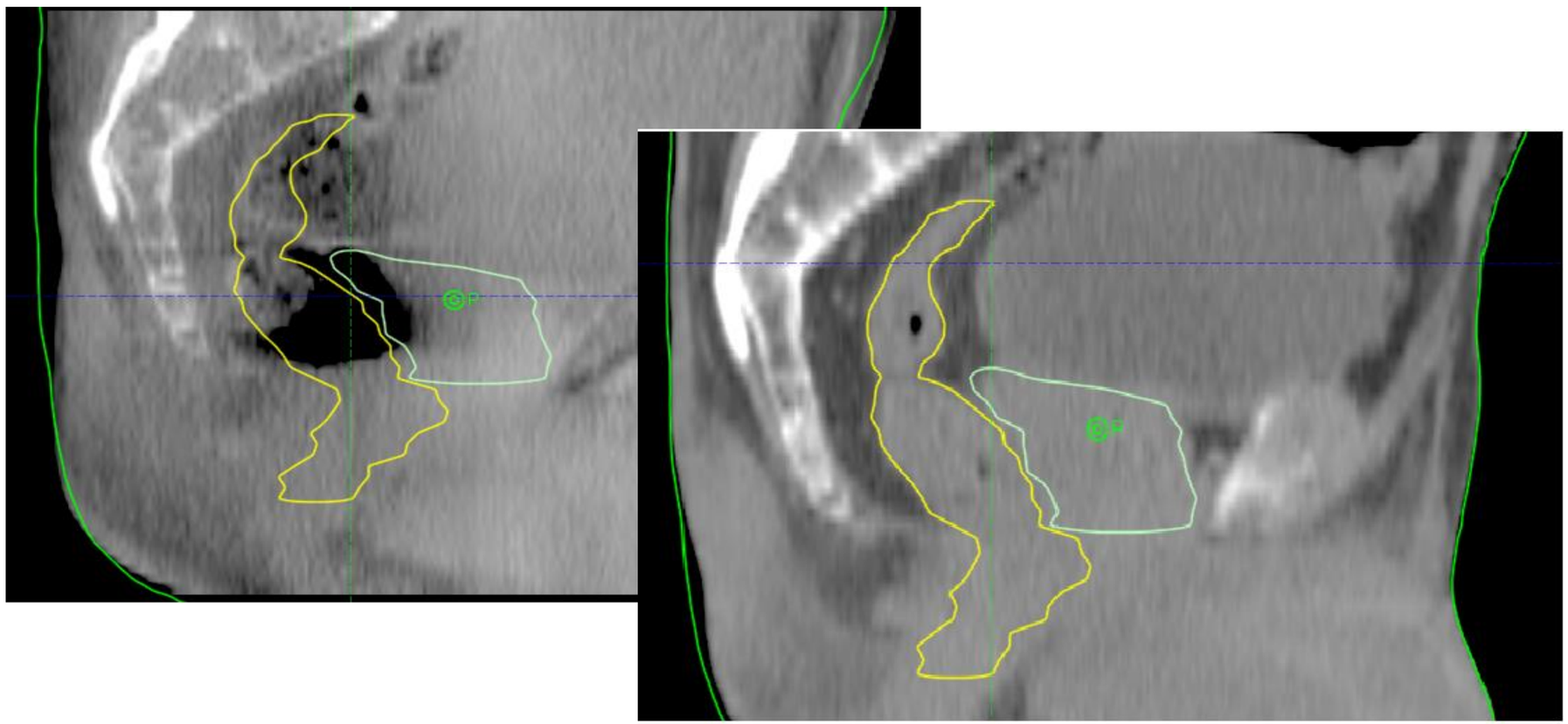
- **Erros aleatórios**
  - Erros de setup do paciente
  - Mudança na metodologia de posicionamento entre as frações.

C2 and P1 - Restricted Information and Basic Personal Data

Erros

- **Erros aleatórios**

  - Posicionamento e forma do tumor



NOVO CBCT

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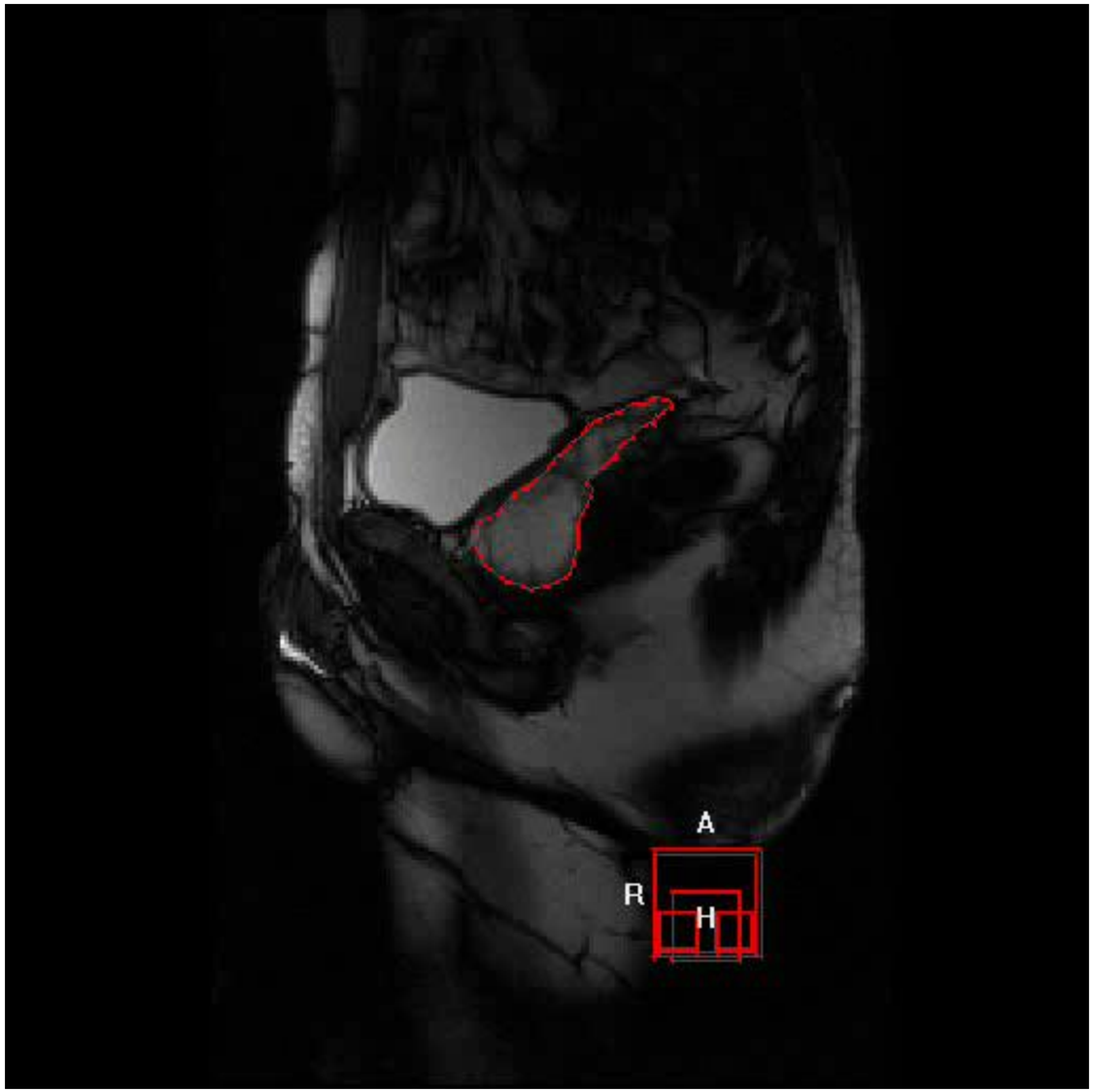
Erros

Erro Randômico

- **Erros aleatórios**
  - Erros intrafrações
  - Movimentos dos órgãos durante o tratamento.

C2 and P1 - Restricted Information and Basic Personal Data

Movimentos dos órgãos



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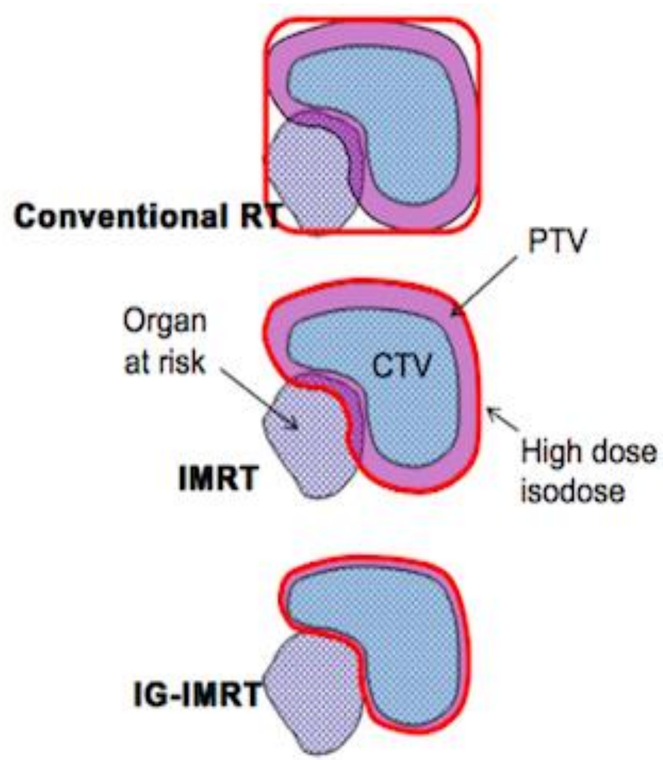
Redução de Margens

- Modulação = Alta conformação
- Com IGRT é possível reduzir margens.



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Qual o Melhor IGRT?

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Qual o Melhor IGRT?

Imagens de KV:

- Doses baixas de radiação; (0.2cGy/exposição)
- Possuem excelente resolução óssea;
- Adequadas para estruturas ligadas aos ossos;
  - Meta óssea;
  - SNC;

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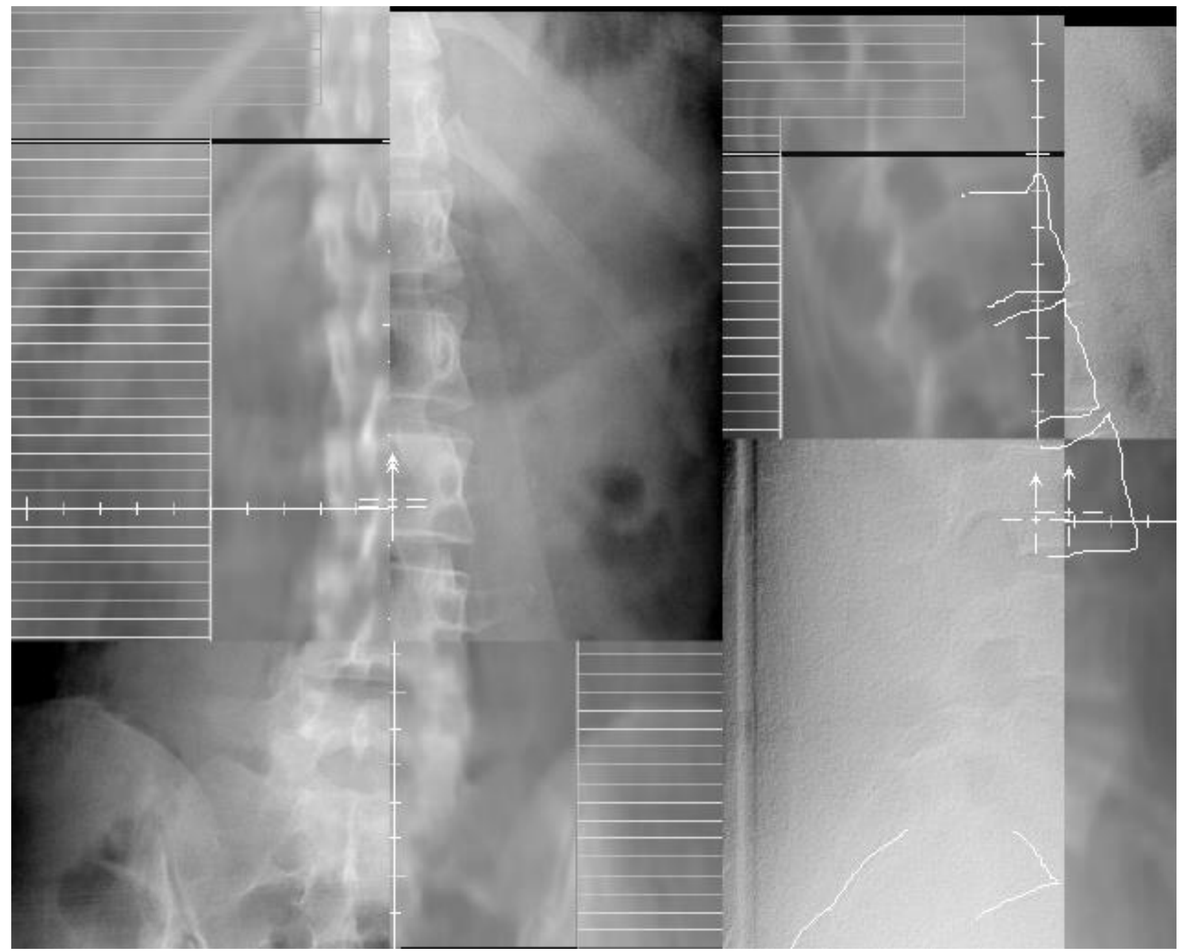
Qual o Melhor IGRT?

Imagens de KV:



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Qual o Melhor IGRT?

Imagens de CBCT:

- Possibilidade de visualização dos alvos;
- Verificação do preparo;
- Analisar o planejamento adaptativo;

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Qual o Melhor IGRT?

Imagens de CBCT:

- Possibilidade de visualização dos alvos;
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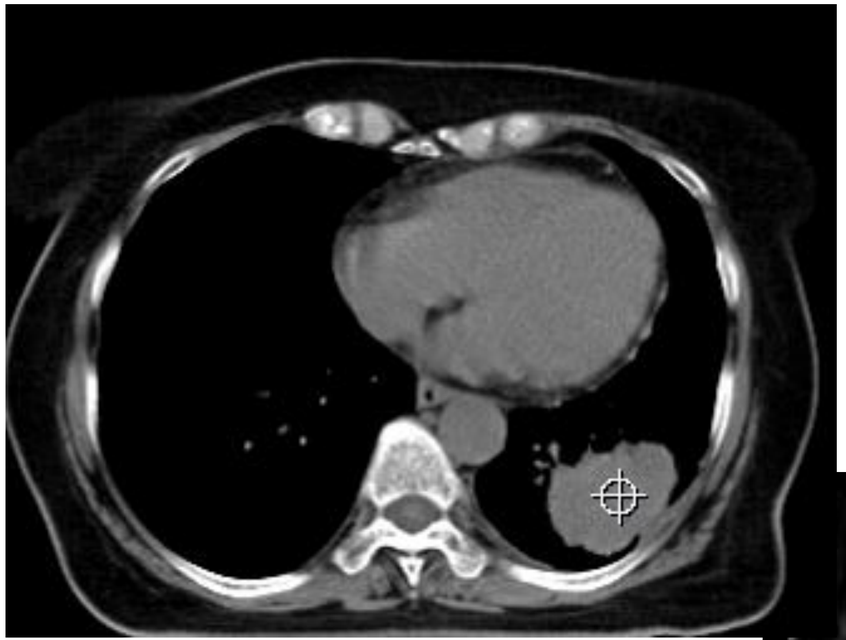
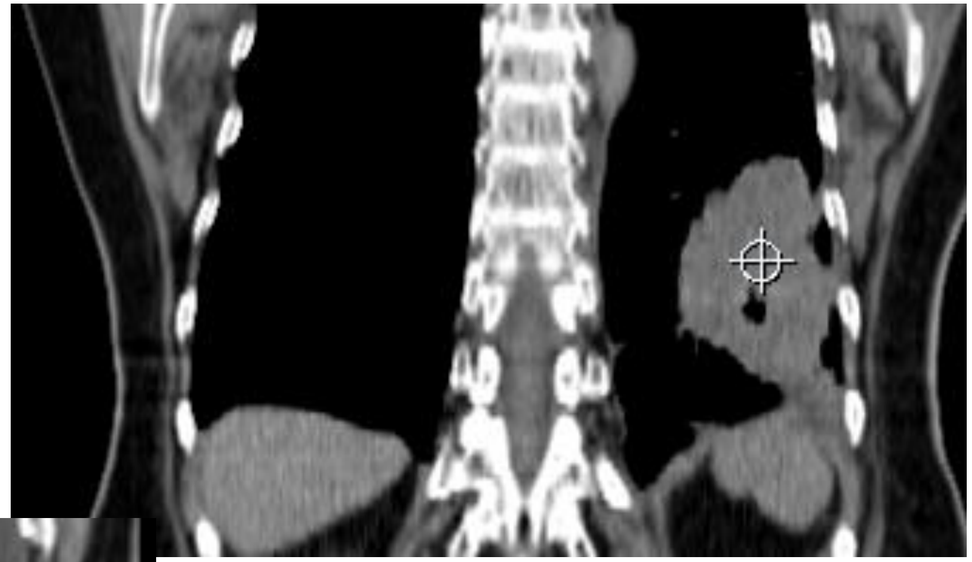
Casos Clínicos – Pulmão





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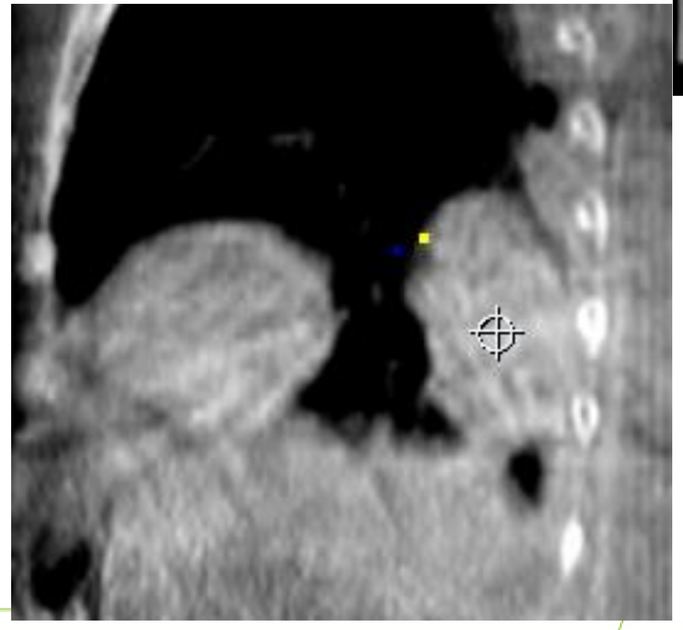
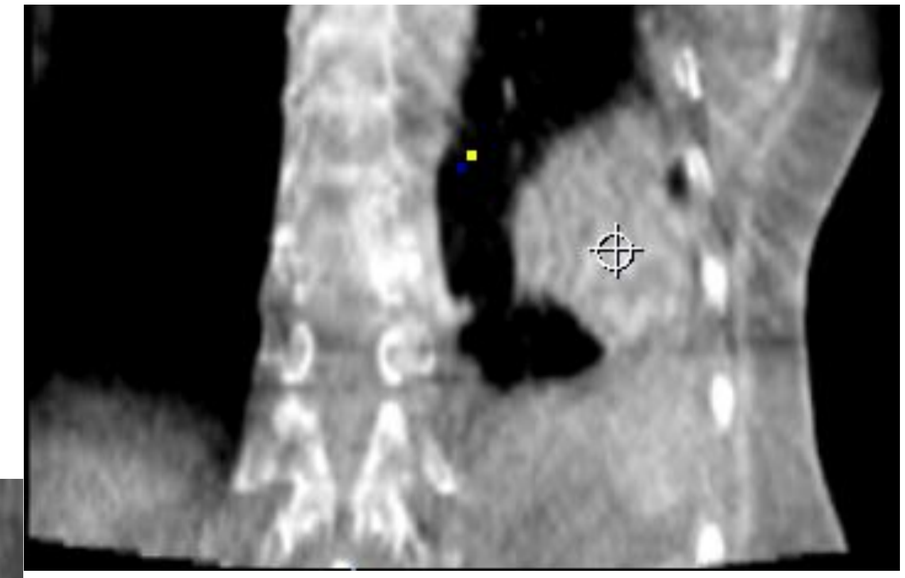
Casos Clínicos – SBRT*





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Qual o Melhor IGRT?

Imagens de CBCT:

- Possibilidade de visualização dos alvos;
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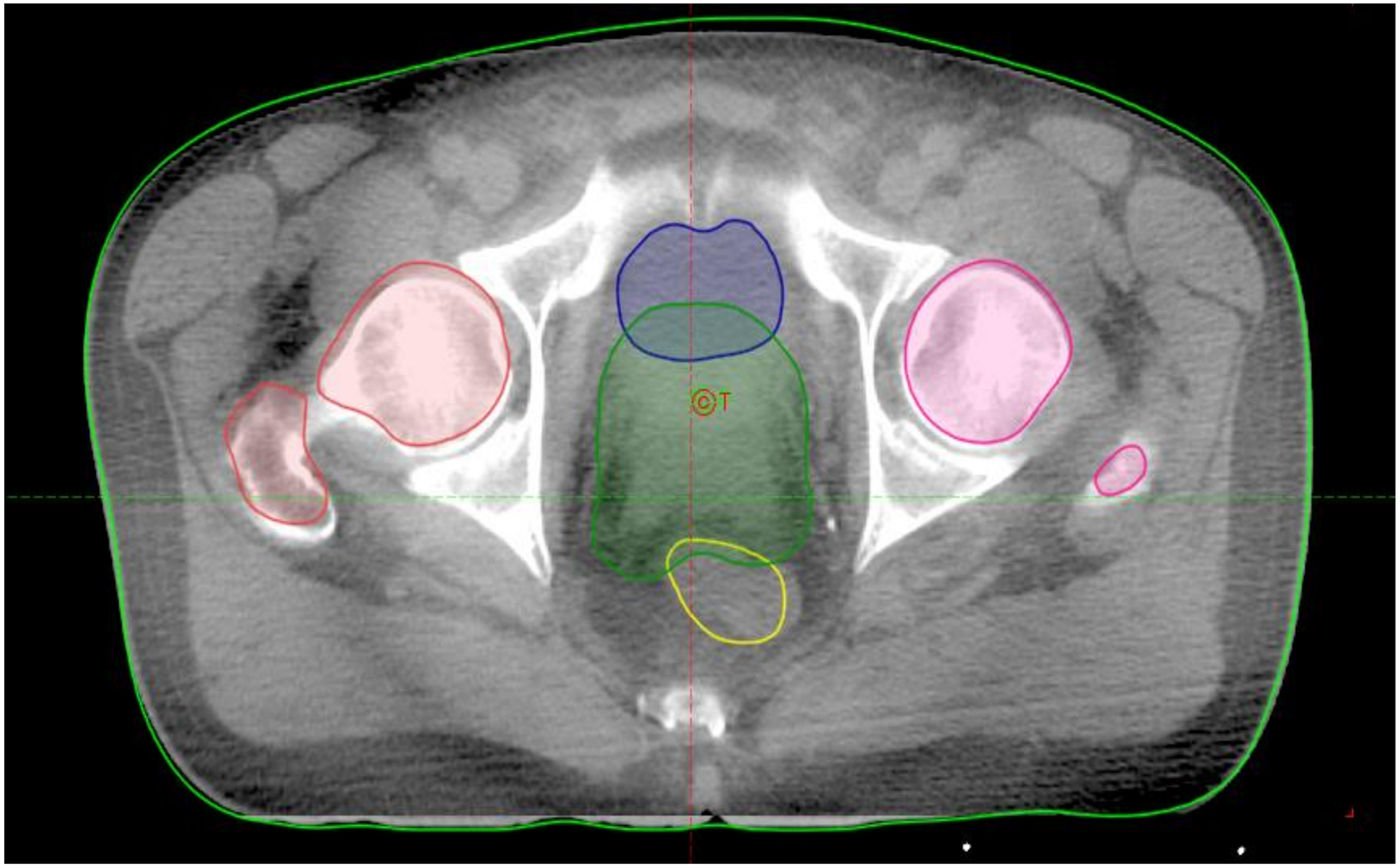
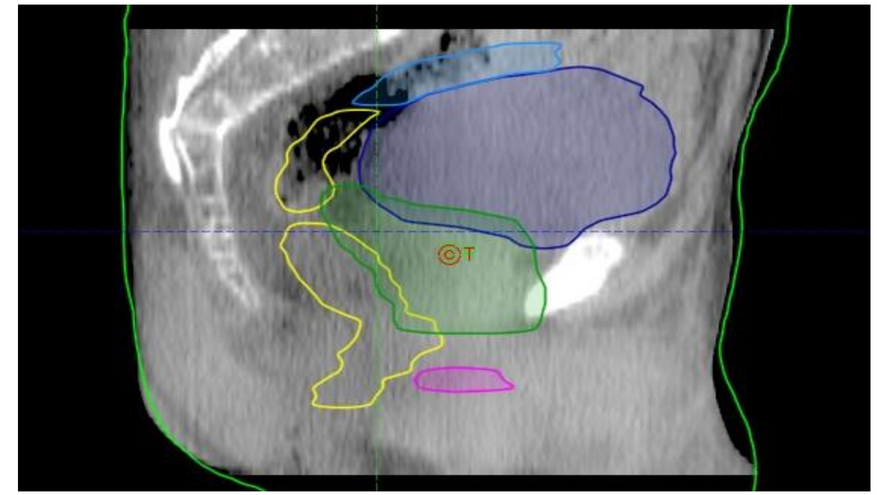
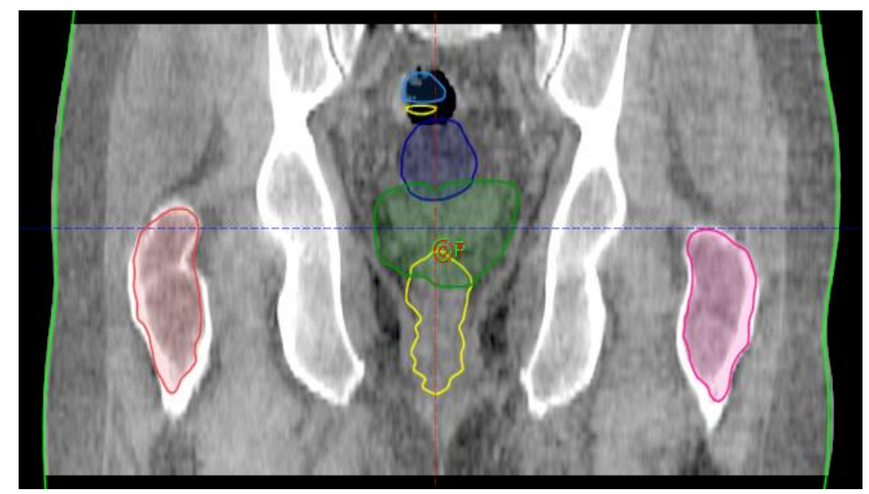
Casos Clínicos - PRÓSTATA







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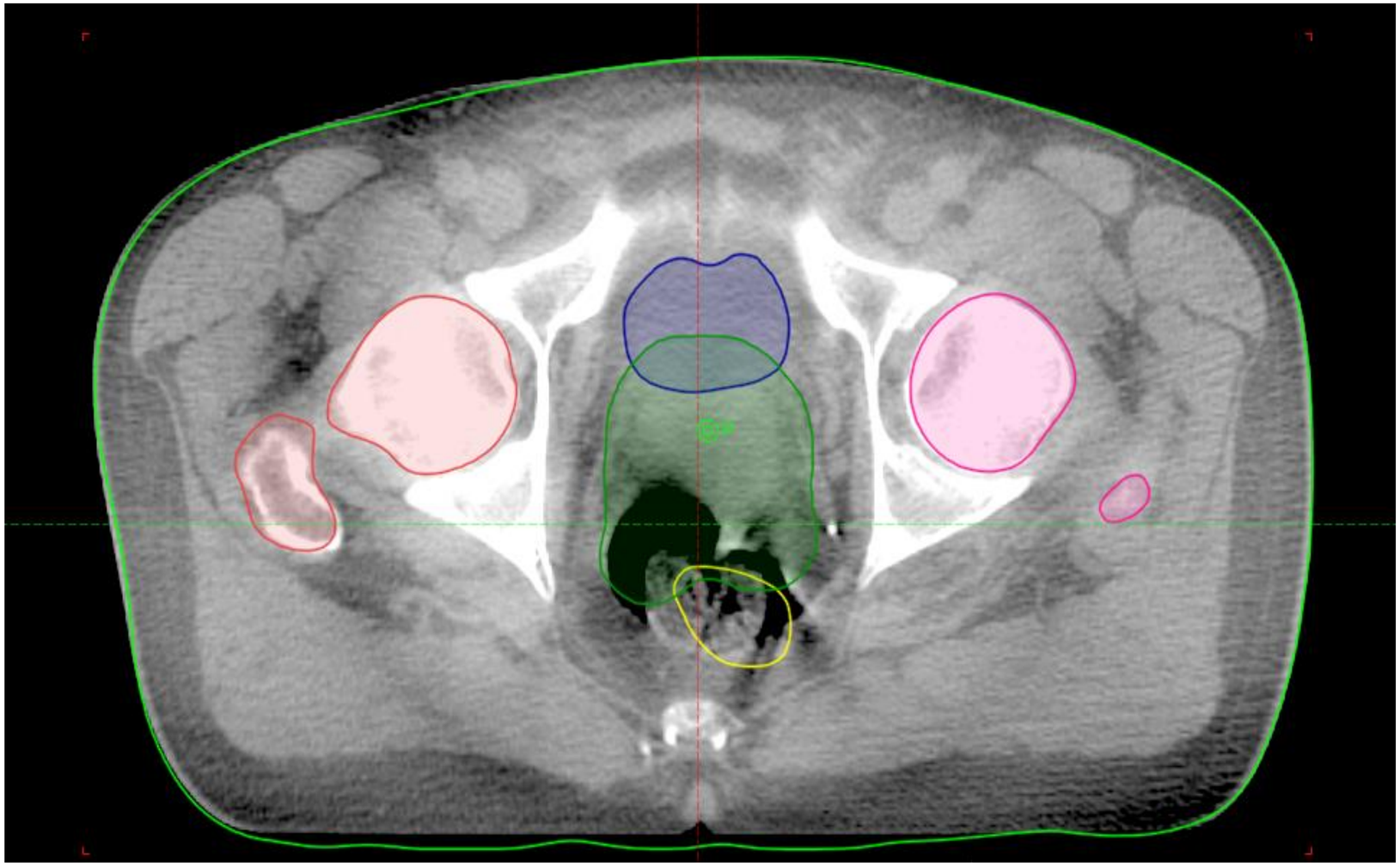
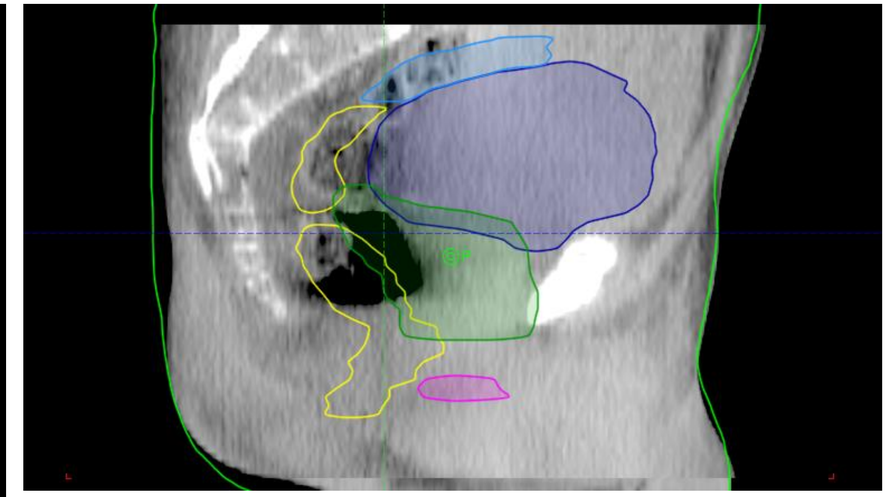
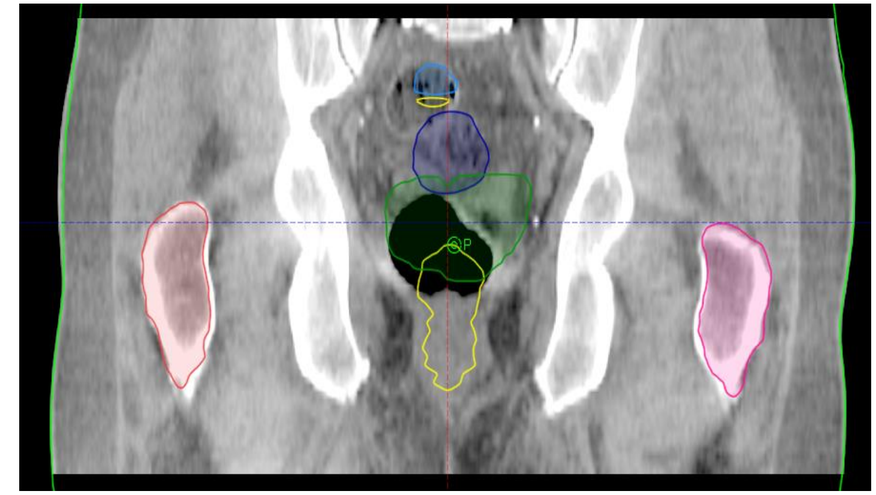
Casos Clínicos - PRÓSTATA







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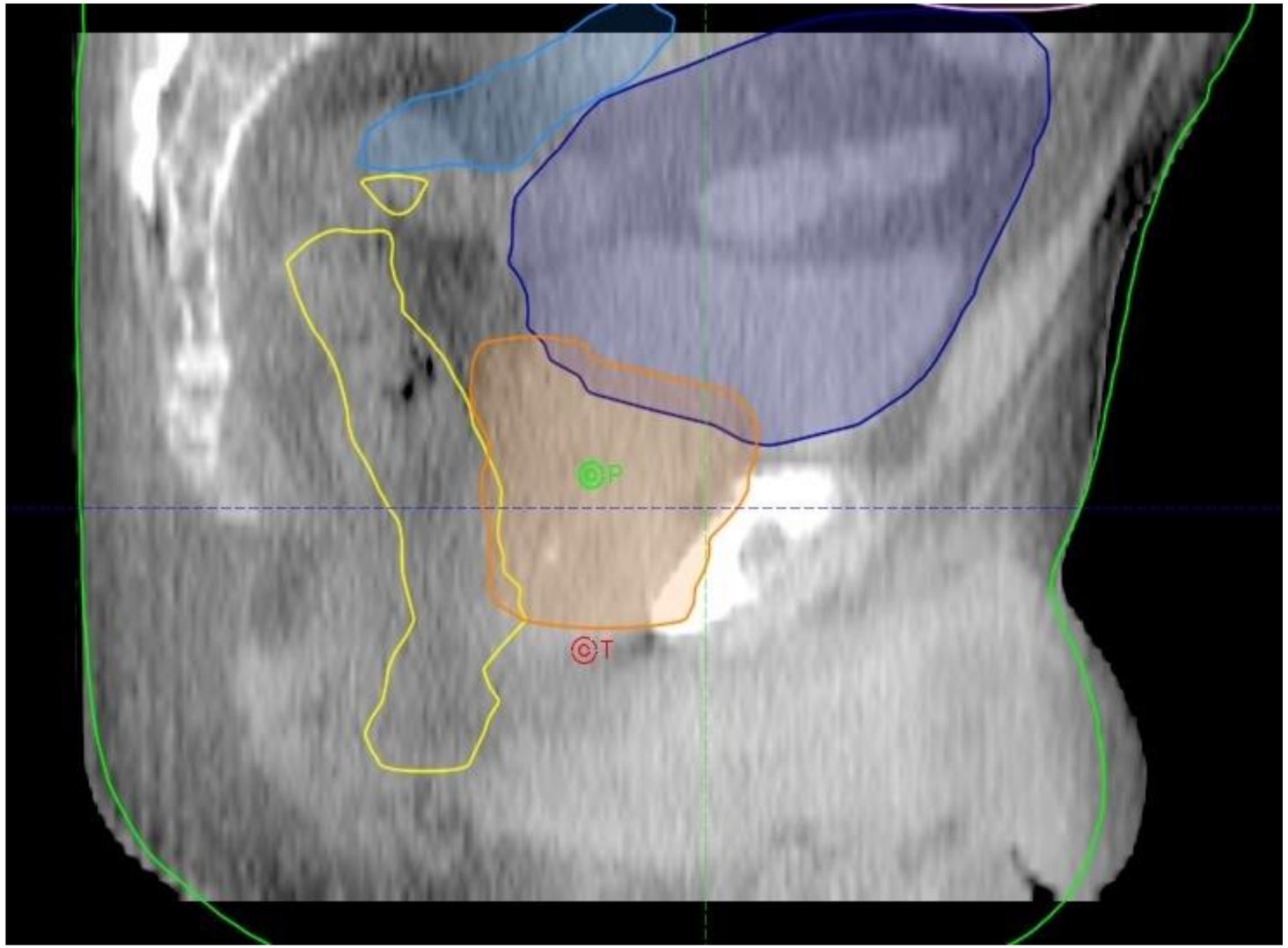

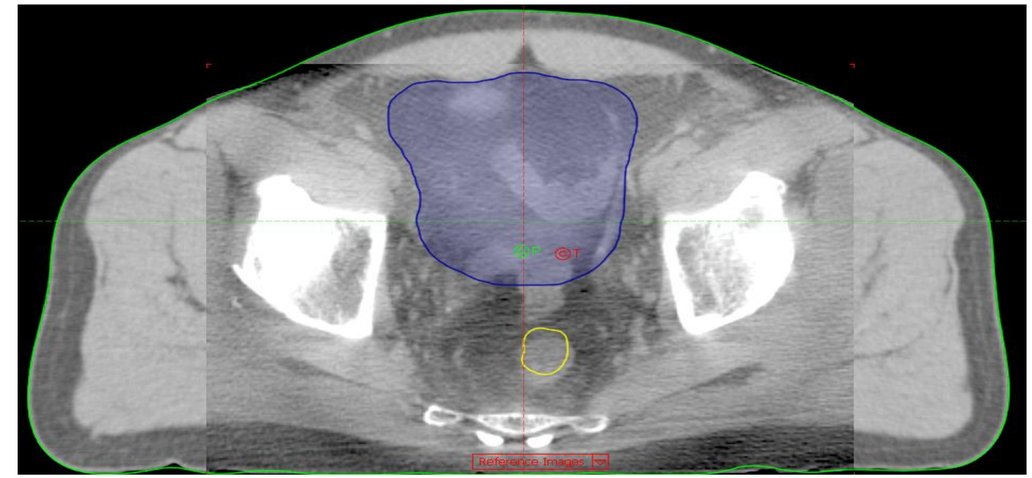

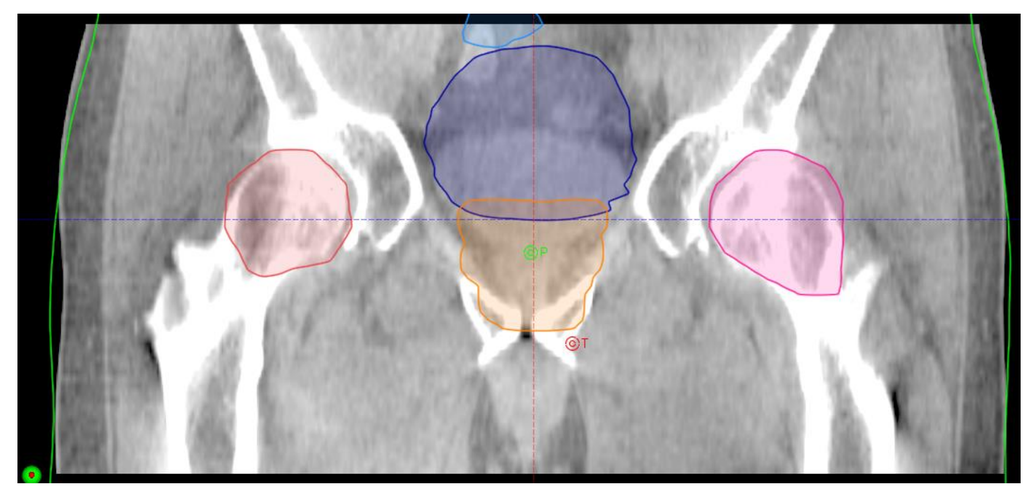

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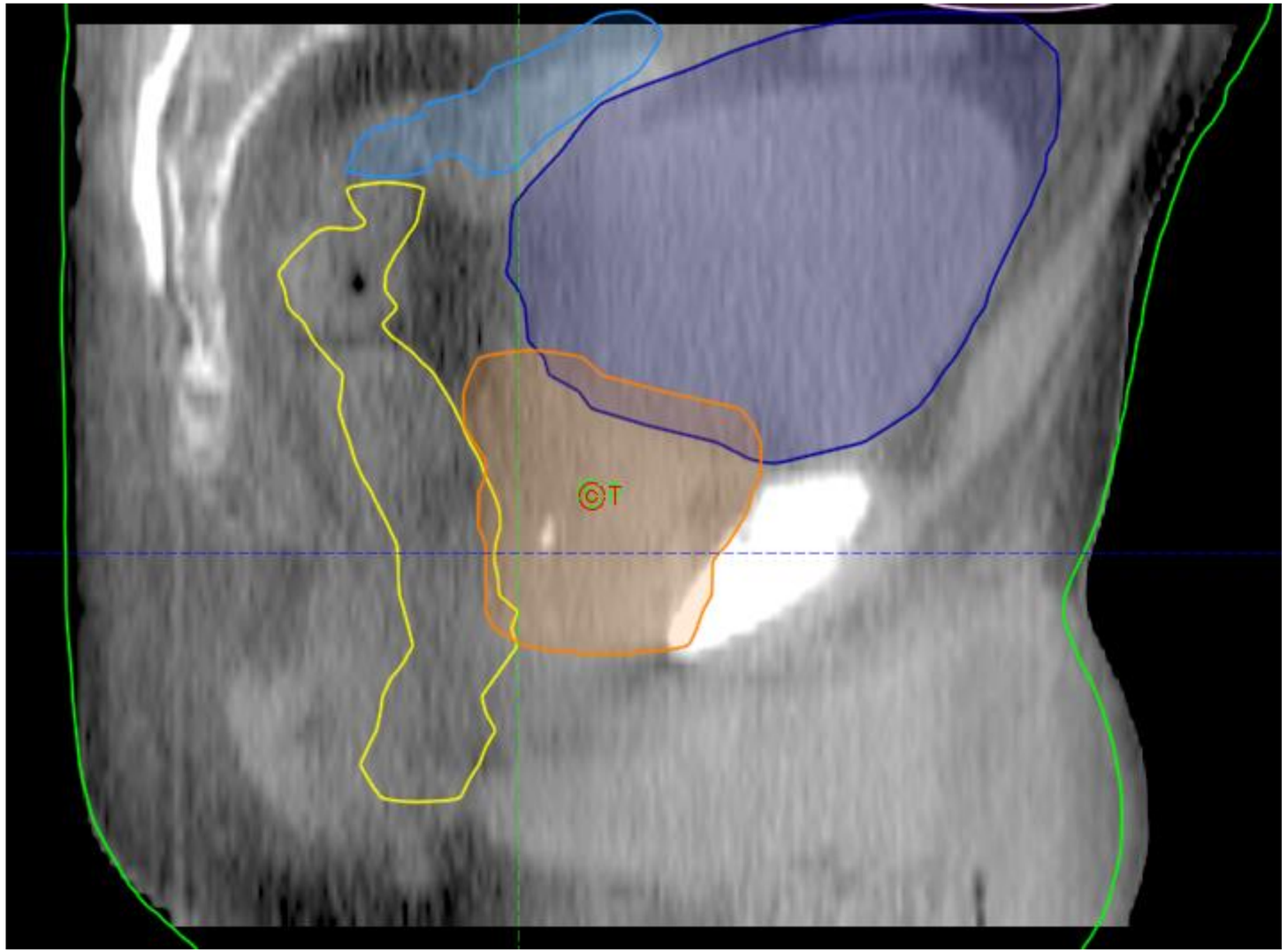
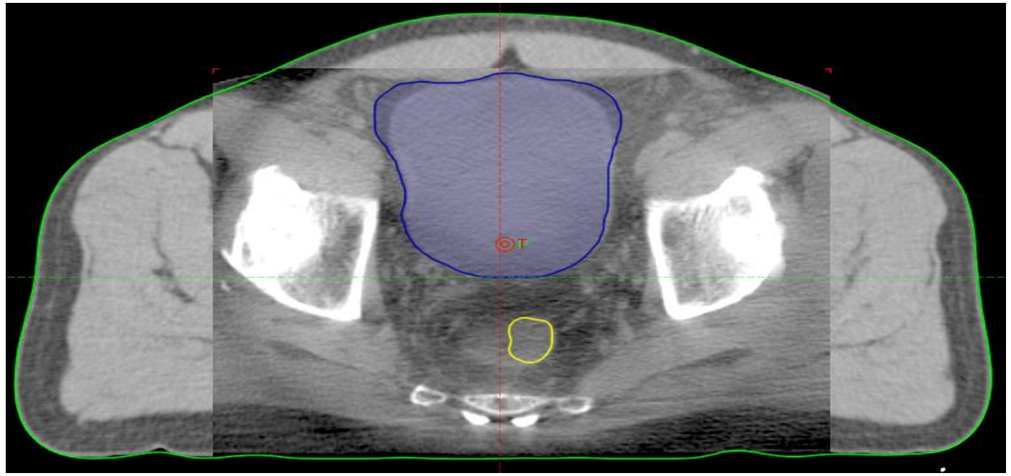
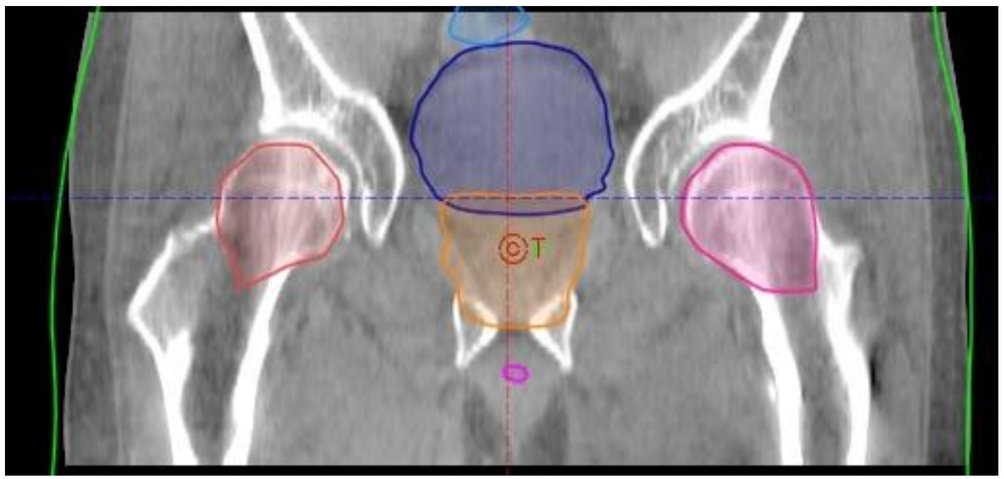
Casos Clínicos - PRÓSTATA







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Qual o Melhor IGRT?

Imagens de CBCT:

- Possibilidade de visualização dos alvos;
- Verificação do preparo;
- Analisar a necessidade de adaptar o planejamento;

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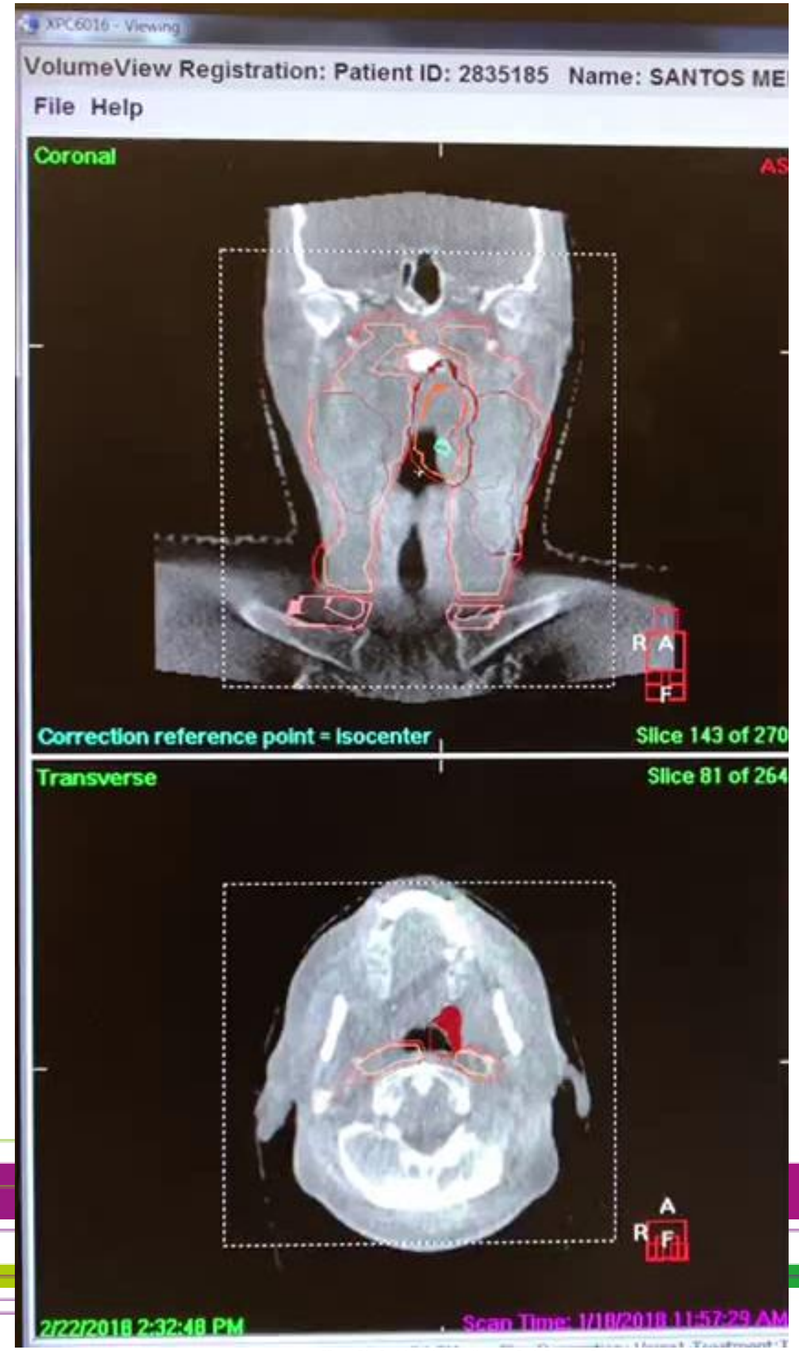
Casos Clínicos H&N



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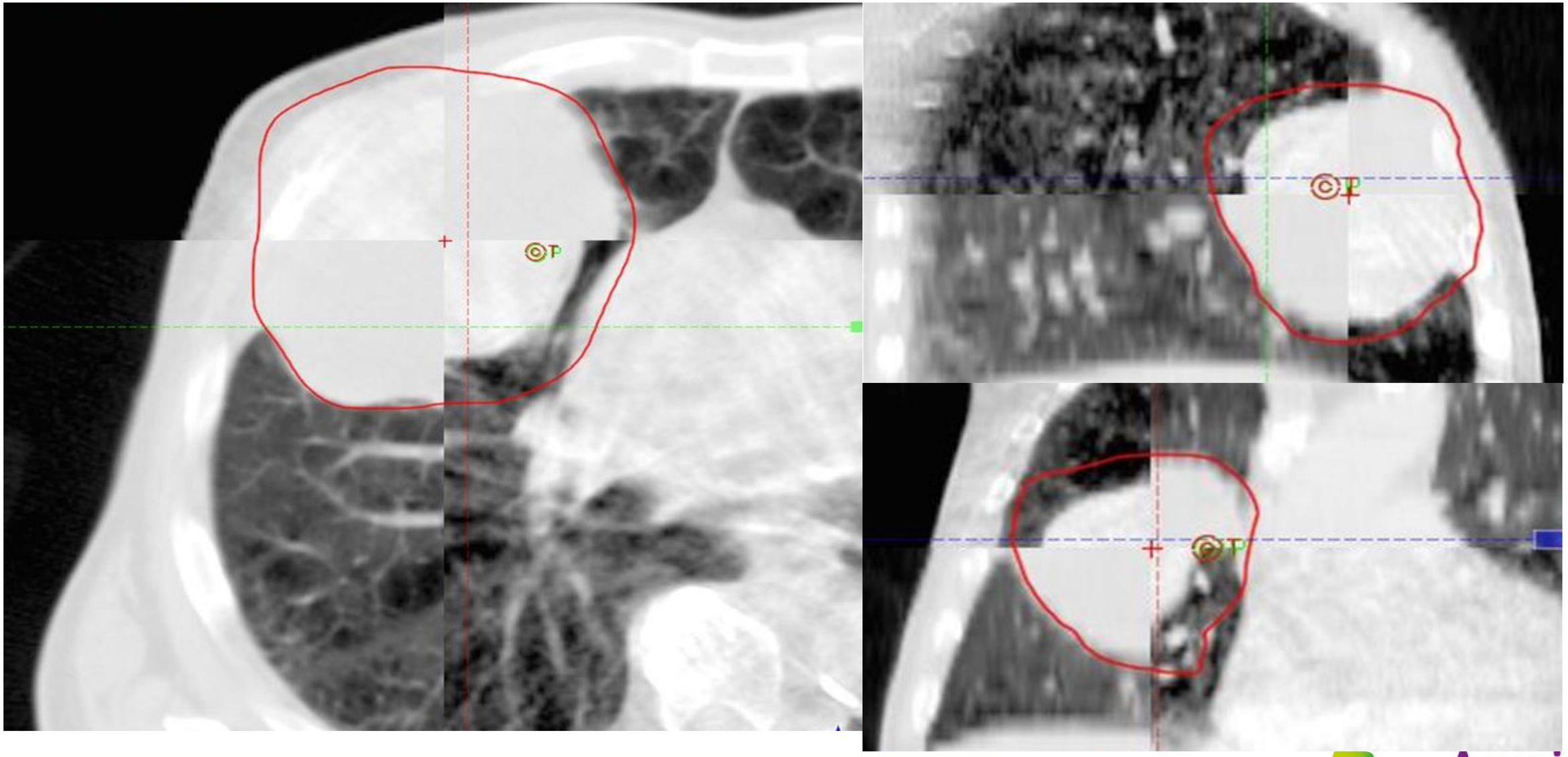
Casos Clínicos – Pulmão



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Doses

Preset	CTDIw (mGy)
CeP (S20)	0,5mGy
Mama (M20)	4,9mGy
Pelvis (S20)	1,5mGy
Simmetry	12,2mGy

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Realidade - Américas

- Em média 50 pacientes tratados diariamente/máquina;
- 15 min/paciente;
- 2 técnico em Radioterapia/turno;
- Correções on line e alguma verificação off-line;

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Protocolo de imagens - Américas

Todas as frações com imagens

CASOS MAIS SIMPLES

1ª,2ª e 3ª fração

Semanal

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Protocolo de imagens - Américas

- Hexapod:

  - ✓ Hipofracionamento: SBRT, SRS, SNC;
  - ✓ Regiões Nobres: FSC Nasal, Proximidade de Tronco e Medula;
  - ✓ Alvos Grandes: Mama Completa; Pelve + Linfonodos; Cabeça e Pescoço; Pulmão
  - ✓ Extremidades;

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Protocolo de imagens - Américas

- Precise:

  - ✓ Próstata;
  - ✓ Mama Simples;
  - ✓ WBRT ou alvo afastado de regiões nobres;
  - ✓ Metástase Óssea.

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C2 and P1 - Restricted Information and Basic Personal Data

Conclusão

- O IGRT deve ser utilizado sempre que estiver disponível;
- É importante discutir a frequência e a modalidade usada para cada paciente de forma individual;
- É importante tanto na qualidade como na segurança do tratamento;
- É imprescindível em tratamentos como SRS e SBRT;
- Exige muito treinamento da equipe e supervisão clínica constante;

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Obrigada!

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marilialima@americasoncologia.com.br

Qual o Melhor IGRT?

Imagens de CBCT:

- Possibilidade de visualizaçãp cíon del blancos;
- Para comprobar la preparación;
- Evaluar la planificación de adaptación;

- Exemplos:
  - Cabeza y coello
  - Prostata;
  - Pulmones;
  - Abdomen;

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IGRT - Definição

Refinar a entrega de dose diaria durante o tratamento de radioterapia com o uso de imagens.

Protocolo de imagens - COI

CASOS ESPECIAIS

1ª fração
2ª fração
3ª fração

Dias que se alternam

Qual o Melhor IGRT?

Imagens de MV:

- Predomínio da interação Compton;

ED: Pulmões: 0,15
Músculo: 1,00
Ar: 0,02 ς 0,04

Exemplo: Imagens do campo de mama;

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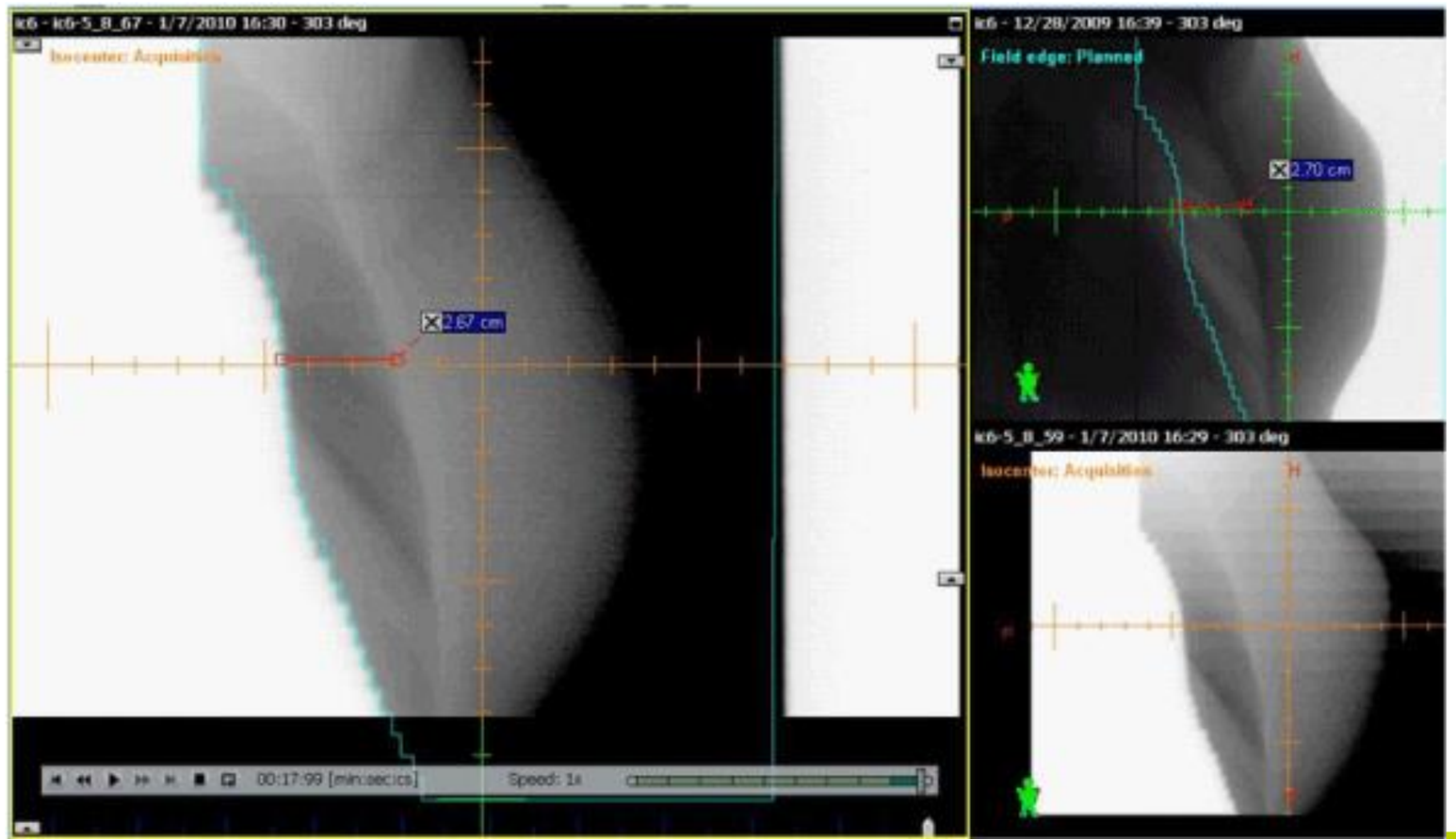
Qual o Melhor IGRT?

Imagens de MV:



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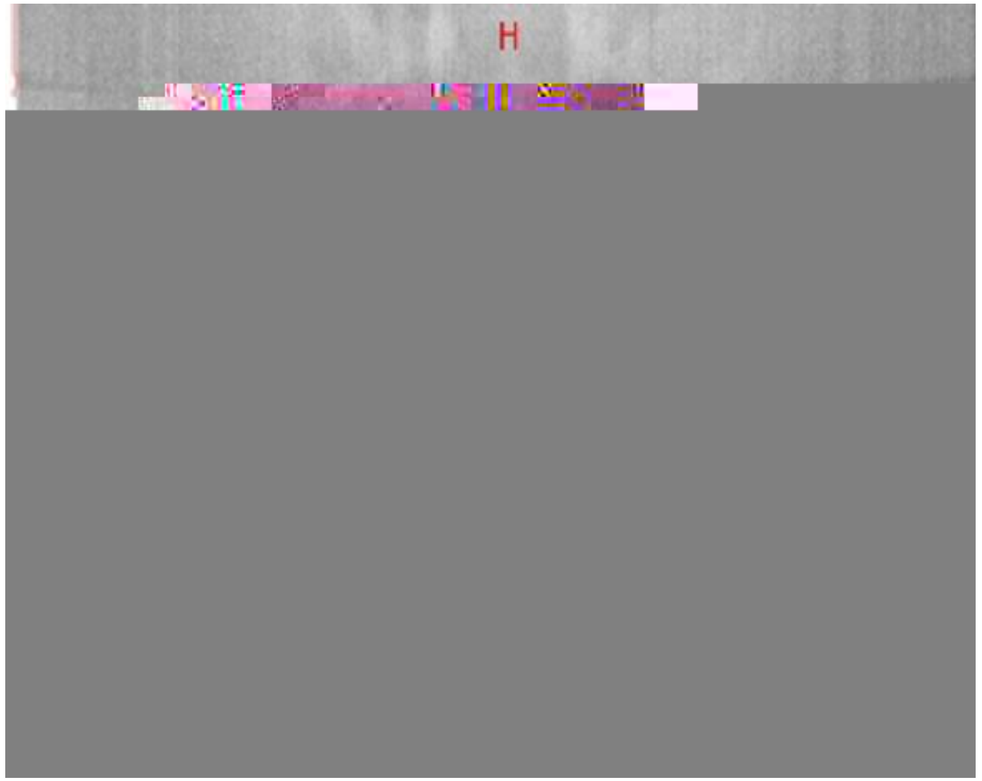
Qual o Melhor IGRT?

- Imagens de MV:
  - Predomínio de interação Compton;
  - ED: Pulmões: 0,15
    Músculo: 1,00
    Ar: 0,02 ς 0,04
    Ossos: 1,12



Qual o Melhor IGRT?

Imagens de KV - interação Fotoelétrica; (Z^3)

Material	Density(g/cm3)	Atomic no	no. Of electrons
[redacted]			

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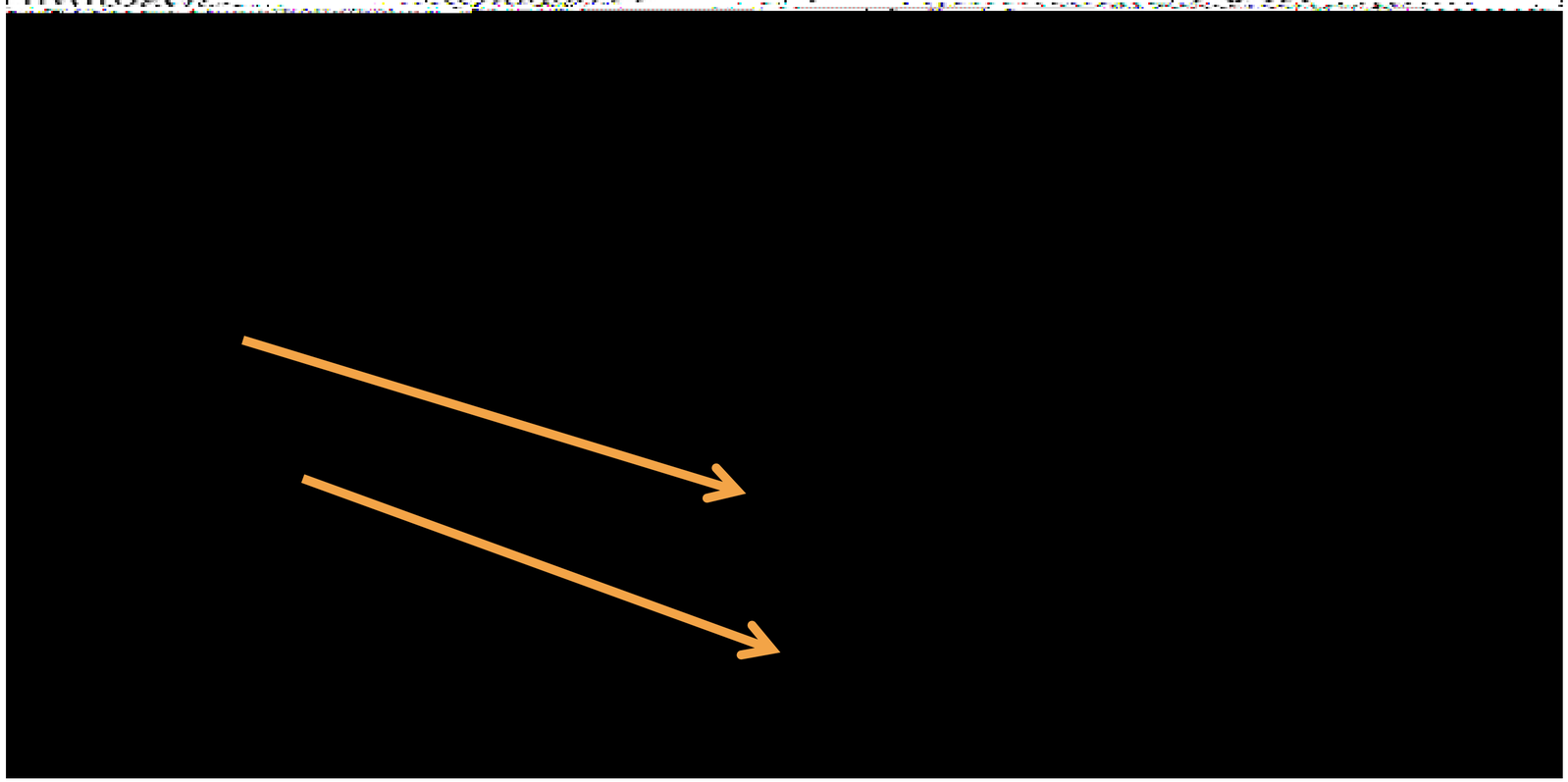
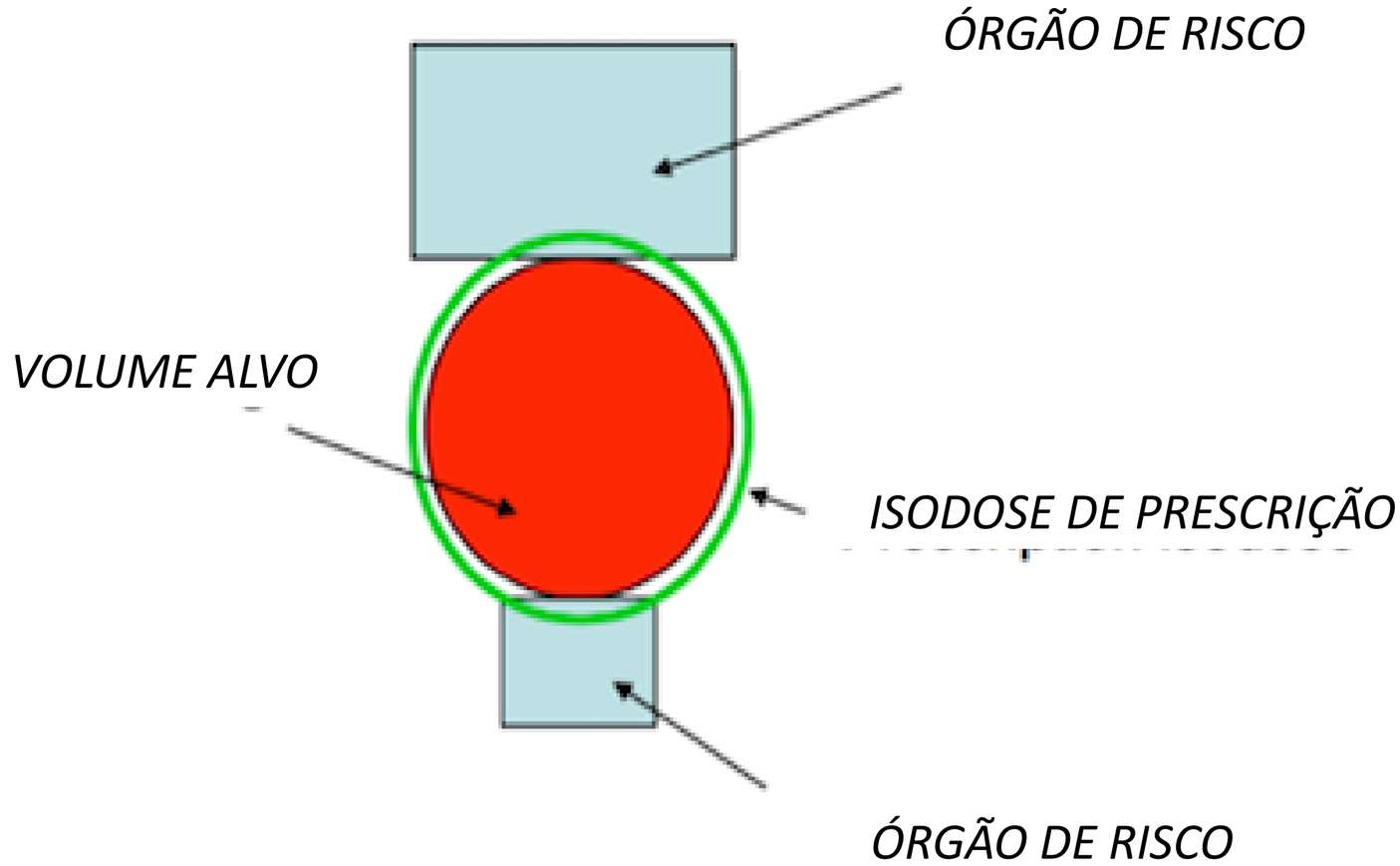
Qual o Melhor IGRT?

Material	Density(g/cm3)	Atomic no	no,. Of electrons per gram
hydrogen	0.0000899	1	[illegible]



Qual o Melhor IGRT?

CONSIDERAÇÕES DO PLANEJAMENTO PARA TRATAMENTO



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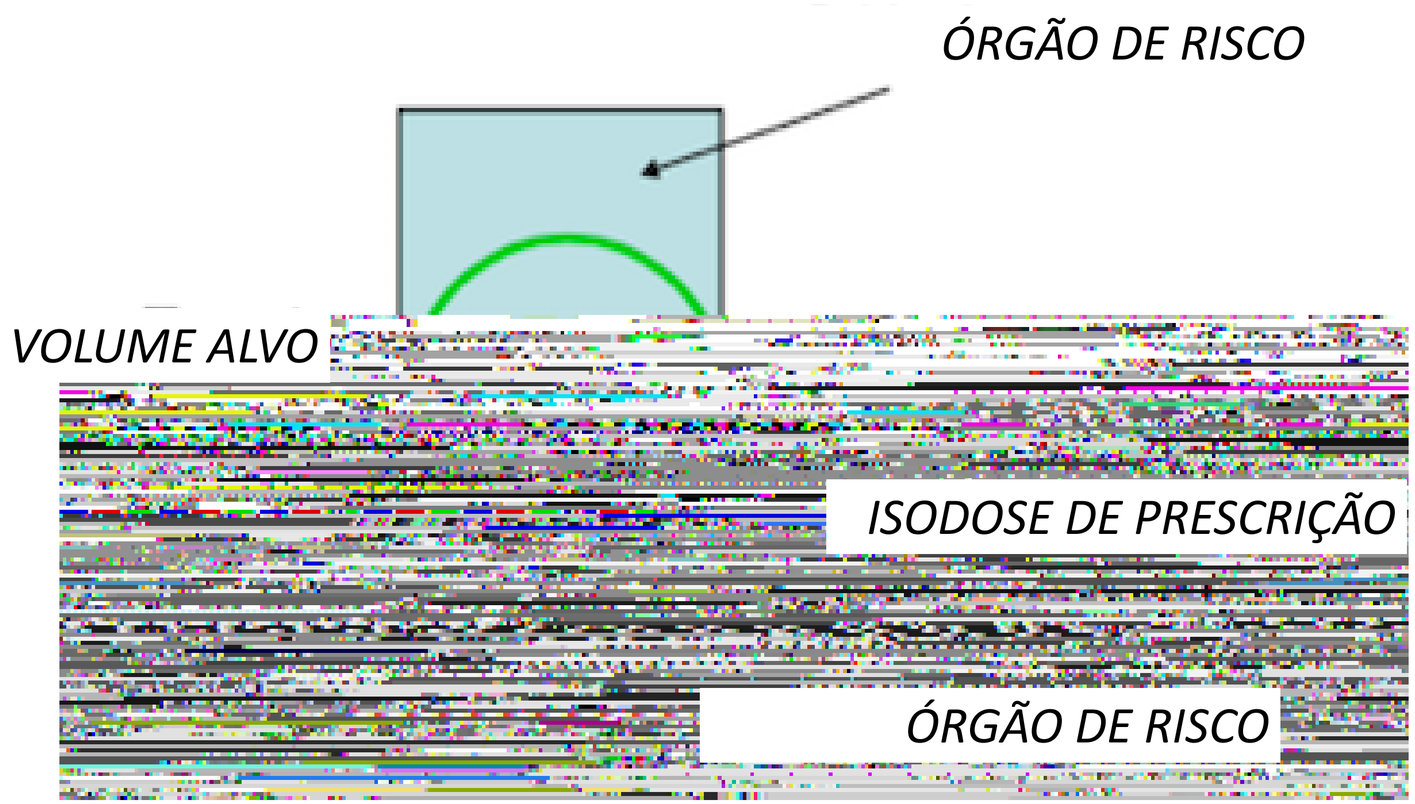
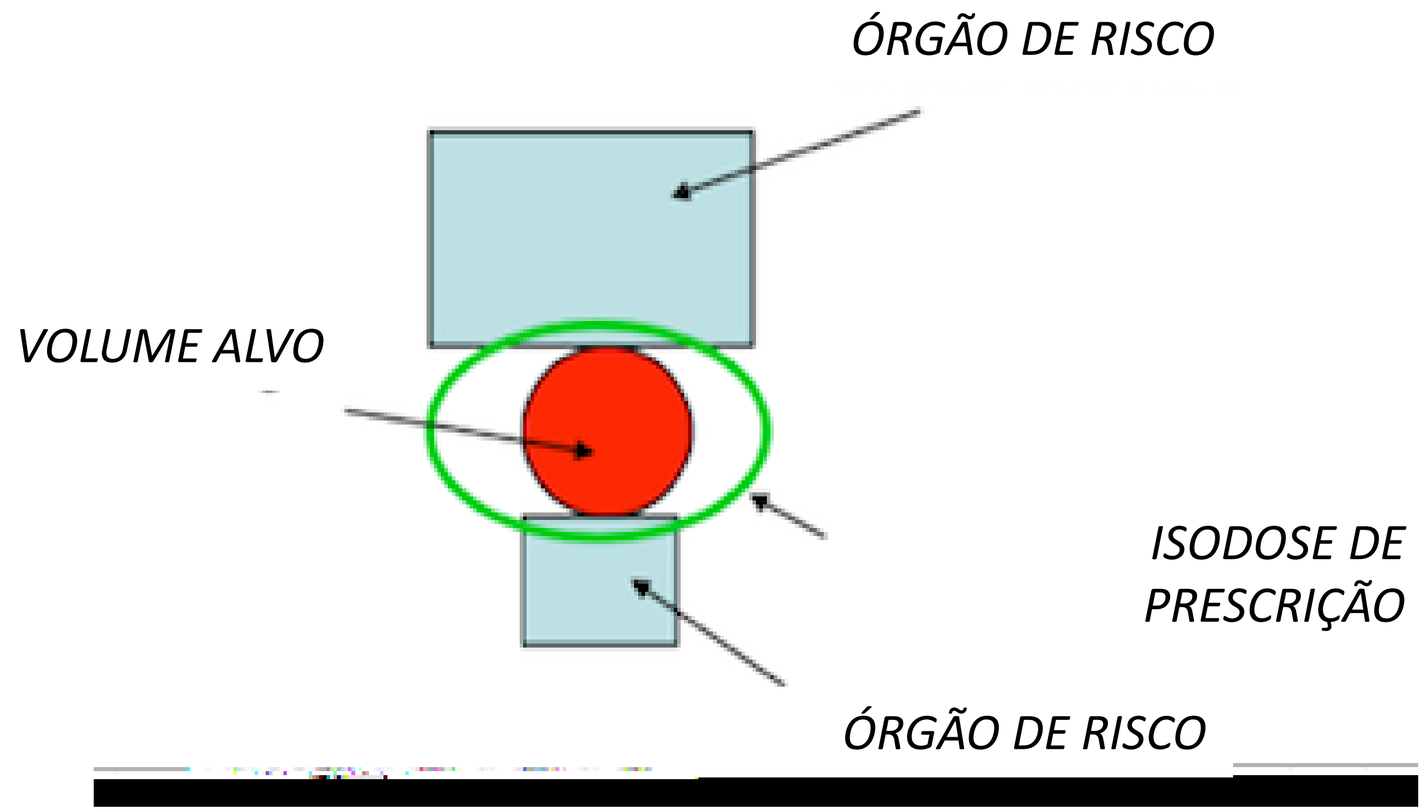
Qual o Melhor IGRT?

CONSIDERAÇÕES DURANTE O TRATAMENTO



Qual o Melhor IGRT?

ADAPTAÇÕES PARA CONTINUIDADE DO TRATAMENTO



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