

SBRT (LUNG) IKN experience

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*Radiographers: Leading The Way to
Diagnosis And Radiation Treatment*

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OUTLINE

1. Introduction
2. Simulation; Immobilization, Protocol
3. Planning; ITV
4. Treatment;
 1. Verification Technique (IGRT)
 2. Tx Technique
5. Case Study; 3 patients
6. Post RT
7. Conclusion

Introduction

- Criteria for SBRT lung;
 - 1) Can the pt be **POSITIONED & IMMOBILIZED**?
 - 2) Can tx planning compensate for **TUMOR MOTION**?
 - 3) Will the tx cover the intended **TARGET** & spare adjacent critical structures?
 - 4) Can the **ACCURACY** of radiation delivery be verified at the time of tx?
- SBRT Lung equipment normally
 - ABC, gating, 4DCT
- We (IKN) done with minimal equipment
 - **BREATHING technique + Abdominal Compression**

Simulation

IMMOBILIZATION DEVICES

- ✓ Highly reproducible, Rigid
- ✓ Comfortable
- ✓ Tx area & immobilization
 - apical tumors : Immobilize H&N (masks)
 - Trunk: Vac-Lok immobilization

Immobilization

Immobilization (IKN)

CDR system

Vac-Lok+

Abdominal Compression



Others (CIVCO)



Immobilization WITH BLUEBAG BODYFIX



Immobilization



Mahidol University
Wisdom of the Land

Immobilization of Edge : Lung, Liver (SBRT)



Body Pro-Lok SBRT



Full(Long) Vac-Lok



Short Vac-Lok+Knee fix



Respiratory Belt



Clam-Lok cushion



Respiratory Plate

Scanning Preparation

✓ Technique to control breathing or motion control;

1) ABC; Active Breathing Control

2) On Line Tracking (4DCT)

3) Gating

4) Coaching Breathing while CT-Sim

(implement at IKN)

✓ Pt preparation if IV contrast

- NBM, allergic status & Renal Function

Technique to control breathing or motion control

1

ACTIVE BREATHING CONTROL (ABC)

- Temporarily immobilizes patient's breathing
- The inspiration and expiration paths of airflow are closed at a predetermined flow direction



Simulation & Contouring Aspects



- Supine
- CT Scan: IV Contrast

Non 4 D CT: The PTV will include the GTV plus an additional 0.5 cm margin in the axial plane and 1.0 cm margin in the longitudinal plane (craniocaudal).

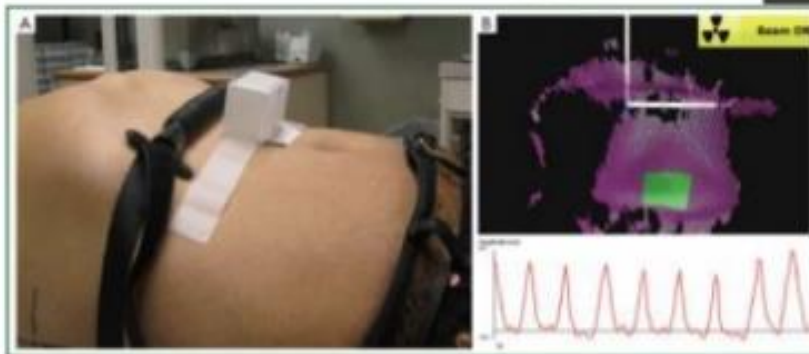
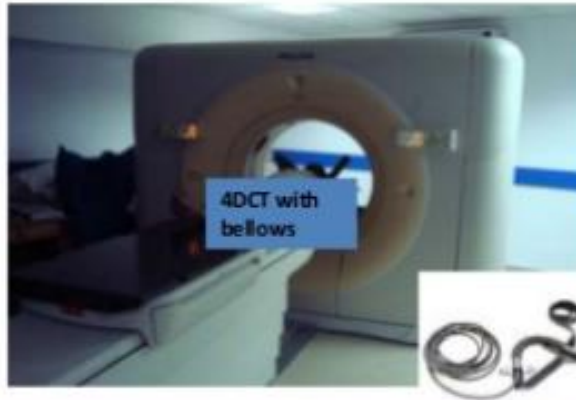
4D CT-simulation: An internal target volume (ITV) around the GTV, accounting for tumor motion may be defined from the 4D CT dataset. The PTV will include the ITV plus an additional 0.5 cm margin uniformly applied to the ITV.

- Slice thickness : ≤ 3.0 mm
- OAR Contouring as follows:

Gating

Respiratory Gating

- 4DCT ; MIP
- Multislice CT & dynamic scans
- Abdominal compression
- evaluation of the target position during maximum inspiration and expiration.



3 Coaching Breathing

- ✓ Coaching patient; CT-Sim
- ✓ Inhale & exhale at certain level
- ✓ Use abdominal compression to restrict the breathing movement
- ✓ Aim: to reduce toxicity (ITV)

Scanning Protocol

A) Plain Thorax

- ✓ Topo_AP, Topo_LAT
- ✓ Control scan at origin '0' with normal breathing
- ✓ Thorax_normal; normal breathing
 - *place one ball bearing at Anterior at level of lesion (to check breathing technique)
 - 2mm slice thickness
 - Set the begin and end of scanning position
 - ** (To scan whole lung: for physic calculation)
- ✓ Inhale
 - scan at lesion area only
 - 2mm slice thickness
 - FOV, Check the scanning time
 - Check the ball bearing at Anterior at level of lesion
- ✓ Exhale
 - scan at lesion area only
 - 2mm slice thickness
 - FOV ***ensure similar with inhale set**

Scanning Protocol

B) CM Thorax

- ✓ Topo_AP, Topo_LAT
- ✓ Control scan at origin '0' with normal breathing
- ✓ Thorax_normal; normal breathing
 - *place one ball bearing at Anterior at level of lesion (to check breathing technique)
 - IV contrast (1.5ml X patient's body weight), flow rate 3.0ml (depends on MO radiologist), Delay time: 60 seconds
 - Set the begin and end of scanning position
 - *** To scan whole lung: for physic calculation)
 - 2mm slice thickness
- ✓ Inhale
 - scan at lesion area only, 2mm slice thickness
 - FOV, Check the scanning time
 - Check the ball bearing at Anterior at level of lesion
- ✓ Exhale
 - scan at lesion area only, 2mm slice thickness
 - FOV ***ensure similar with inhale set**

Scanning Protocol

Tips & tricks:

Normal breathing: ball bearing at slice "0"

Inhale: ball bearing not at 0, normally at slice +ve (eg:4)

Exhale: ball bearing not at 0, normally at slice -ve (eg:-2)

Post processing

- Image Manipulation Function
- t-MIP: algorithm
- tMIP (temporal maximum intensity projection):
 - To calculate the temporal minimum intensity projection (tMinIP) or the temporal maximum intensity projection (tMaxIP) volumes from multiphase data

Planning

✓ Margin

- GTV (tumour): Normal breathing images
- ITV (Internal Target Volume) :
 - < 1cm margin: tMIP (tMinIP and tMaxIP)

** Reduce toxicity

- PTV (set-up error) 3-5mm

** Floating mass ; \pm 1cm movement

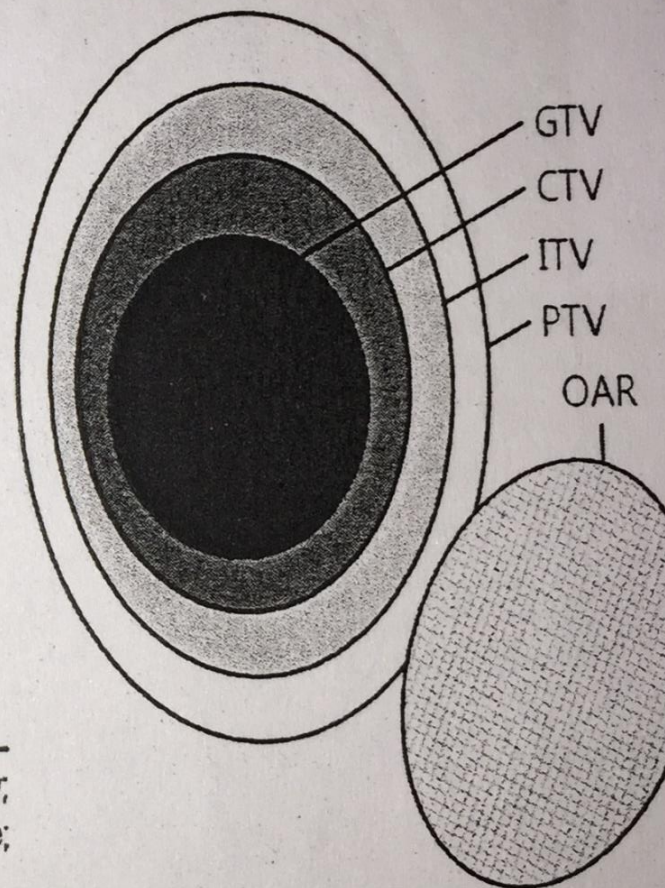
✓ Follow RTOG SBRT Protocol

✓ **Lateral movement: Couch limitation

Preparation for Radiation Therapy

- Acquisition of CT (MR, PET-CT)
- Contouring

Volume	Definition
GTV	GTV is defined by imaging the tumor using contemporary diagnostic imaging modalities such as MRI, CT or PET.
CTV	CTV extends beyond GTV and accounts for potential microscopic spread of the tumor.
ITV	ITV accounts for displacement of tumors particularly during respiratory motion.
PTV	PTV can extend beyond CTV, to ensure appropriate treatment of entire CTV considering variation in radiation delivery due to lack of reproducibility between treatment setup, between fractions and/or organ motion during therapy.
OAR	OAR's are normal organs or tissues for which dose is constrained, so that the delivered dose is lower than tissue tolerance.

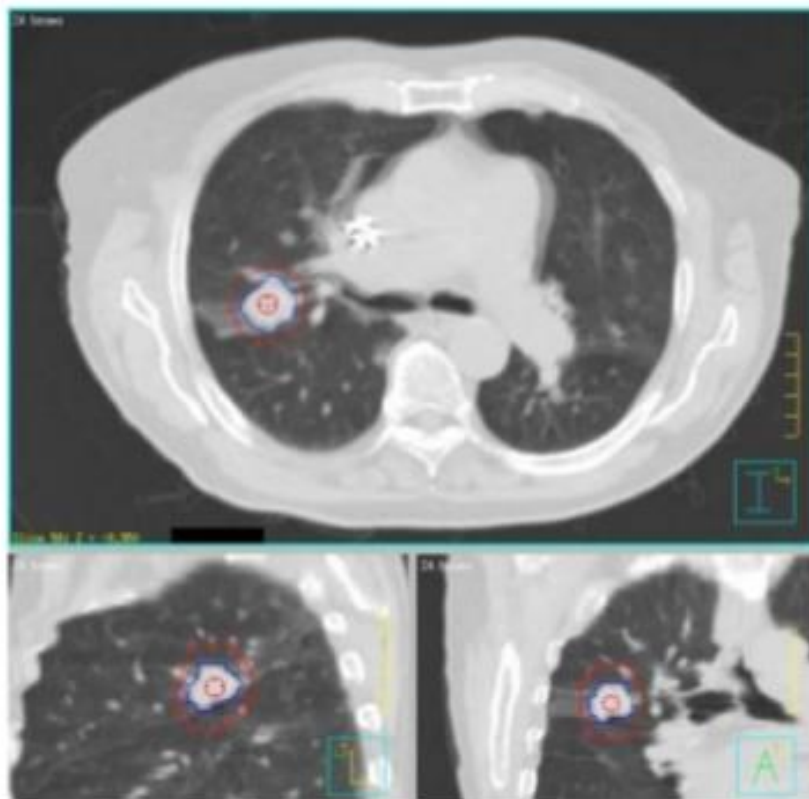


GTV, gross tumor volume; MRI, magnetic resonance imaging; CT, computed tomography; PET, positron emission tomography; CTV, clinical target volume; ITV, internal target volume; PTV, planning target volume; OAR, organ at risk..

Contouring

Clip slide

- MIP images for Target volume contouring
- $GTV = CTV = ITV$ (MIP)
- Contouring on lung windows
- Image fusion to confidently identify target margin
- $PTV = ITV + 3-5 \text{ mm}$
- GTV= Gross tumor volume, CTV= Clinical target volume, PTV= planning target volume

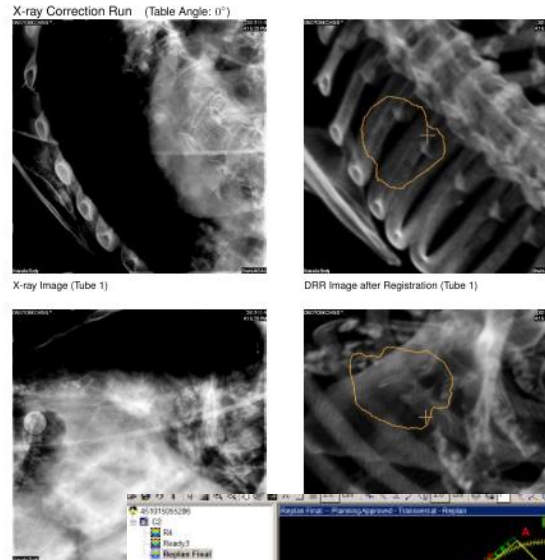


Treatment

1) Verification: Extrac → CBCT

Exactrac

- 2D, kV
- Positioning



CBCT

- 3D, kV
- Check Isocenter



Treatment

1) Tolerance

- ✓ Exactrac
- ✓ CBCT: 2mm

2) Tx technique

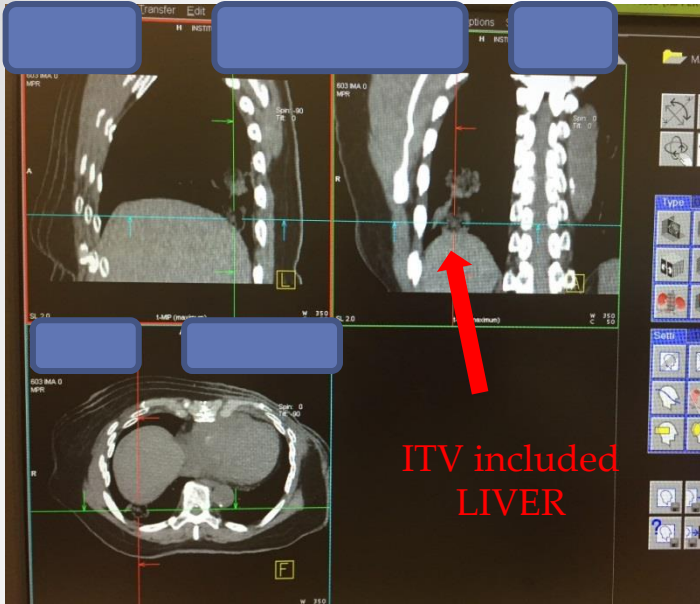
- ✓ VMAT
- ✓ Partially Arc (IKN: normally 4 Arch)

Case Study (1)

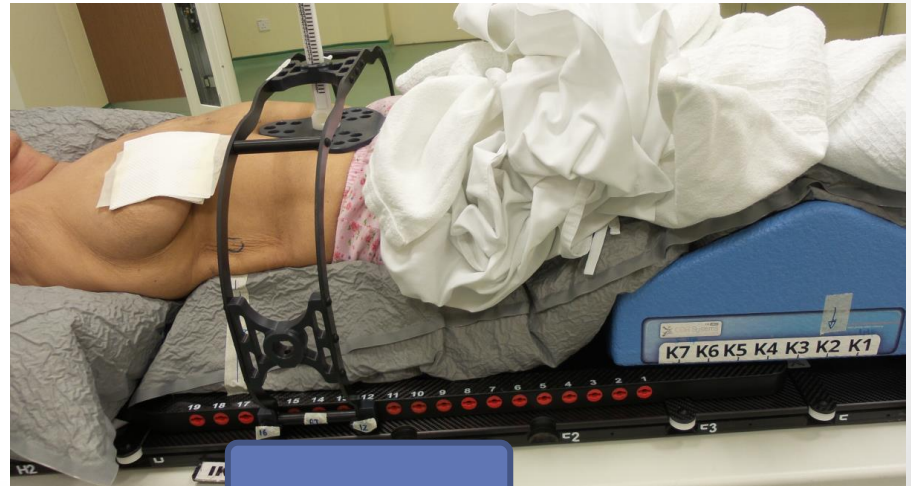
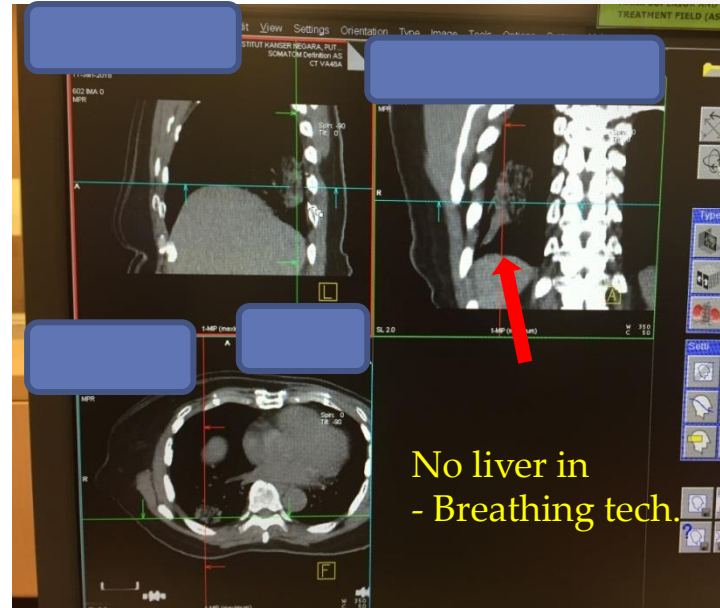
- F/64y.o/Ca Breast with Lung Mets
- 48Gy/4# @ Apex of the Rt Lung/ 4 Arch
- 13/7/2017
- 14/7/2017
- 17/7/2017
- 18/7/2017



4th January



RESIM:11 January



Post RT

- F/up
 - Review: 1 month post RT with CXR
 - CT-TAP: Periodic, to evaluate tumour size
 - 2 months
 - 8 months

CONCLUSION

- Set-up
 - 3D: Easy positioning, minimum set-up device
 - SBRT: Immobilization device
- Tx – duration
 - 3D: 5 or 10#
 - SBRT: 4#

Thank You

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