

# Identifying best practice through the unification of guidelines for patient preparation, immobilization and imaging in four radiotherapy centers in two countries

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## PURPOSE

The purpose of this project is to create unified guidelines for the preparation, immobilization and imaging of patients that will undergo radiation therapy in four centers in two countries, in order to ensure safe and best practice.

## METHOD

A working group comprising of one medical physicist (MP) and one radiation therapy technologist (RTT) from each center was formed. The following categories were defined for the scope of the project:

- I Head and head & neck: for brain, head and neck and craniospinal irradiation
- II Pelvis: for gynecological, anus, rectum and genitourinary system irradiation
- III Chest: for lung, breast, pancreas, gastric system and esophagus irradiation
- IV Limbs: for lower and upper limbs irradiation
- V Individual: for the construction of individual immobilization vacuum mattresses

A template table was created and distributed to the centers to provide information for the process followed for patient preparation, immobilization and computed tomography (CT) scanning protocol parameters used for each of the above categories, including reference point and radiopack markers position. Collected data was analyzed and the best guidelines for each category were determined taking into account differences in immobilization devices and imaging, as well as radiation therapy equipment of individual centers.

## RESULTS

Following the information obtained from individual centers, a unified technical instruction was created for each category, detailing the immobilization and imaging process to be followed:

IMMOBILIZATION & IMAGING INSTRUCTIONS FOR LIMBS	
Preparation	<ul style="list-style-type: none"> <li>Remove clothes (lower part of the body)</li> <li>Remove underwear</li> <li>Remove jewelry</li> </ul>
Immobilization	<b>Devices</b> <ul style="list-style-type: none"> <li>Vacuum Bag</li> <li>HeadSTEP</li> <li>Pillow and knee support</li> </ul>
	<b>Technique</b> <ul style="list-style-type: none"> <li>Prone / supine</li> <li>Head first (arms)</li> <li>Feet first (legs)</li> </ul>
	<b>Fixation/Indexing</b> <ul style="list-style-type: none"> <li>Fixed or indexed immobilization</li> </ul>
	<b>Reference point</b> <ul style="list-style-type: none"> <li>Center of PTV</li> </ul>
Imaging	<b>Protocol</b> <ul style="list-style-type: none"> <li>Limbs</li> <li>120kV</li> <li>3mm or less for radical patient</li> </ul>
	<b>CT markers</b> <ul style="list-style-type: none"> <li>Radio-opaque markers at reference point (cross points)</li> </ul>
	<b>Scanning range</b> <ul style="list-style-type: none"> <li>Treated region with margin</li> <li>All tissues to be irradiated must be included in CT scans</li> </ul>

IMMOBILIZATION & IMAGING INSTRUCTIONS FOR PELVIS (Gynecological, Anus, Rectum, Genitourinary System, Bladder Cancer)					
Preparation	<ul style="list-style-type: none"> <li>Remove clothes (lower part of body)</li> <li>Remove underwear</li> <li>Remove any jewelry</li> </ul>				
Bladder preparation	<table border="0"> <tr> <td>Gynecological, Anus, Rectum, Genitourinary</td> <td> <ul style="list-style-type: none"> <li>Ask patient to empty bladder</li> <li>Ask patient to drink 500ml water</li> <li>Ask patient to wait for 30-60min</li> </ul> </td> </tr> <tr> <td>Bladder</td> <td> <ul style="list-style-type: none"> <li>Empty bladder</li> </ul> </td> </tr> </table>	Gynecological, Anus, Rectum, Genitourinary	<ul style="list-style-type: none"> <li>Ask patient to empty bladder</li> <li>Ask patient to drink 500ml water</li> <li>Ask patient to wait for 30-60min</li> </ul>	Bladder	<ul style="list-style-type: none"> <li>Empty bladder</li> </ul>
Gynecological, Anus, Rectum, Genitourinary	<ul style="list-style-type: none"> <li>Ask patient to empty bladder</li> <li>Ask patient to drink 500ml water</li> <li>Ask patient to wait for 30-60min</li> </ul>				
Bladder	<ul style="list-style-type: none"> <li>Empty bladder</li> </ul>				
Immobilization	<b>Devices</b> <ul style="list-style-type: none"> <li>Pillow under the head</li> <li>Knee and feet support</li> <li>Belly board (when prone position is used for rectum/anus)</li> <li>Vacuum bag (optional)</li> </ul>				
	<b>Technique</b> <ul style="list-style-type: none"> <li>Arms on chest</li> <li>Secure patient comfort to avoid movement</li> <li>Ask patient to stay relaxed, calm and to breath normally</li> </ul>				
	<b>Fixation/Indexing</b> <ul style="list-style-type: none"> <li>Fixed or indexed immobilization where available</li> </ul>				
	<b>Reference point</b> <ul style="list-style-type: none"> <li>Sagittal: in the middle of patient</li> <li>Axial: between superior anterior iliac spine and pubic symphysis</li> <li>Coronal: at the level of femoral head or at the level of the iliac crest</li> </ul>				
Imaging	<b>Protocol</b> <ul style="list-style-type: none"> <li>Pelvic protocol</li> <li>120kV</li> <li>Large FOV</li> <li>2.5 - 3.0mm slice thickness</li> </ul>				
	<b>CT markers</b> <ul style="list-style-type: none"> <li>Radio-opaque markers at reference point (cross points)</li> </ul>				
	<b>Scanning range</b> <ul style="list-style-type: none"> <li>From L3 to end of pelvic region</li> </ul>				

IMMOBILIZATION & IMAGING INSTRUCTIONS FOR HEAD & NECK (Oropharynx, larynx, hypopharynx, nasopharynx)	
Preparation	<ul style="list-style-type: none"> <li>Remove any jewelry</li> <li>Remove prosthetic/artificial teeth</li> <li>Remove clothes (upper part of the body)</li> </ul>
Immobilization	<b>Devices</b> <ul style="list-style-type: none"> <li>5-point mask</li> <li>Head support</li> <li>Blocks &amp; wedges</li> <li>Vacuum cushion (optional)</li> </ul>
	<b>Technique</b> <ul style="list-style-type: none"> <li>Arms down</li> <li>Prepare mask</li> <li>Mask hole for the nose</li> <li>Relaxed shoulders</li> <li>Retractor belt (optional)</li> </ul>
	<b>Fixation/Indexing</b> <ul style="list-style-type: none"> <li>Fixed and indexed immobilization</li> </ul>
	<b>Reference point</b> <ul style="list-style-type: none"> <li>Sagittal &amp; Axial Lasers: At the planning area</li> <li>Coronal Laser: set in position that the immobilization device is visible in images</li> </ul>
Imaging	<b>Protocol</b> <ul style="list-style-type: none"> <li>Head protocol</li> <li>120kV</li> <li>2.0 - 3.0mm slice thickness</li> </ul>
	<b>CT markers</b> <ul style="list-style-type: none"> <li>Radio-opaque markers at reference point (cross points)</li> </ul>
	<b>Scanning range</b> <ul style="list-style-type: none"> <li>The whole head adding 2 slices above and under</li> <li>Scan the immobilization device and the table top.</li> </ul>

IMMOBILIZATION & IMAGING INSTRUCTIONS FOR CHEST (Lung, Pancreas, Stomach, Esophageal Cancer)	
Preparation	<ul style="list-style-type: none"> <li>Remove clothes (upper part of the body)</li> <li>Remove jewelry and artificial objects</li> <li>Remove wig</li> </ul>
Immobilization	<b>Devices</b> <ul style="list-style-type: none"> <li>Supine position</li> <li>Chest immobilization device with pillow and arms support</li> <li>Knee support</li> </ul>
	<b>Technique</b> <ul style="list-style-type: none"> <li>Arms above the head</li> <li>Normal breathing</li> </ul>
	<b>Fixation/Indexing</b> <ul style="list-style-type: none"> <li>Fixed or indexed immobilization</li> </ul>
	<b>Reference point</b> <ul style="list-style-type: none"> <li>Sagittal midline of patient</li> <li>Axial crossing xiphoid</li> <li>Coronal in midaxillary line</li> </ul>
Imaging	<b>Protocol</b> <ul style="list-style-type: none"> <li>Chest</li> <li>120kV</li> <li>2.5 - 3.0 mm slice thickness</li> </ul>
	<b>CT markers</b> <ul style="list-style-type: none"> <li>Radio-opaque markers at reference point (cross points)</li> </ul>
	<b>Scanning range</b> <ul style="list-style-type: none"> <li>C5 to L2</li> <li>All tissues to be irradiated must be included in CT scans</li> </ul>

IMMOBILIZATION & IMAGING INSTRUCTIONS FOR CHEST (Breast Cancer)	
Preparation	<ul style="list-style-type: none"> <li>Remove clothes (upper part of the body)</li> <li>Remove jewelry and artificial objects</li> <li>Remove wig</li> </ul>
Immobilization	<b>Devices</b> <ul style="list-style-type: none"> <li>Supine position</li> <li>Breast immobilization device with pillow and arms support</li> <li>Knee support</li> </ul>
	<b>Technique</b> <ul style="list-style-type: none"> <li>Arms above the head</li> <li>Normal breathing</li> <li>Chest inclination (5-15°) if needed</li> </ul>
	<b>Fixation/Indexing</b> <ul style="list-style-type: none"> <li>Fixed or indexed immobilization</li> </ul>
	<b>Reference point</b> <ul style="list-style-type: none"> <li>Sagittal midline of patient</li> <li>Axial crossing xiphoid process</li> <li>Coronal in midaxillary line</li> </ul>
Imaging	<b>Protocol</b> <ul style="list-style-type: none"> <li>Chest</li> <li>120kV</li> <li>2.5 - 3.0 mm slice thickness</li> </ul>
	<b>CT markers</b> <ul style="list-style-type: none"> <li>Radio-opaque markers at reference point (cross points)</li> </ul>
	<b>Scanning range</b> <ul style="list-style-type: none"> <li>C1 to L2</li> <li>All tissues to be irradiated must be included in CT scans</li> </ul>

IMMOBILIZATION & IMAGING INSTRUCTIONS FOR HEAD (Brain & oral cavity)	
Preparation	<ul style="list-style-type: none"> <li>Remove any jewelry (necklace, earrings etc.)</li> <li>Remove prosthetic/artificial teeth</li> </ul>
Immobilization	<b>Devices</b> <ul style="list-style-type: none"> <li>3-point mask</li> <li>Head support</li> <li>Blocks &amp; wedges</li> </ul>
	<b>Technique</b> <ul style="list-style-type: none"> <li>Arms down</li> <li>Prepare mask</li> <li>Mask hole for the nose</li> <li>Mask hole for the mouth (optional)</li> </ul>
	<b>Fixation/Indexing</b> <ul style="list-style-type: none"> <li>Fixed and indexed immobilization</li> </ul>
	<b>Reference point</b> <ul style="list-style-type: none"> <li>Sagittal &amp; Axial Lasers: Between the eyebrows by the middle line</li> <li>Coronal Laser: at the middle of head height</li> </ul>
Imaging	<b>Protocol</b> <ul style="list-style-type: none"> <li>Head protocol</li> <li>120kV</li> <li>2.0 - 3.0mm slice</li> </ul>
	<b>CT markers</b> <ul style="list-style-type: none"> <li>Radio-opaque markers at reference point (cross points)</li> </ul>
	<b>Scanning range</b> <ul style="list-style-type: none"> <li>The whole head adding 2 slices above and under</li> <li>Scan the immobilization device and the table top.</li> </ul>

IMMOBILIZATION INSTRUCTIONS FOR VACUUM BAGS	
Preparation	<ul style="list-style-type: none"> <li>Flatten out the cushion to distribute the filling evenly</li> <li>Position the patient on the cushion, and connect the hose to the cushion and vacuum pump.</li> <li>Start the vacuum pump and generate a slight vacuum, then stop the pump. Mold the cushion around the body to provide the desired positioning</li> </ul>
Localization	<ul style="list-style-type: none"> <li>Vacuum Bag can be used alone or as an additional accessory</li> </ul>
Technique	<ul style="list-style-type: none"> <li>Reproduce the patient's shape by modeling the mattress.</li> <li>The inner material of the mattress can be moved to the side where we need more. This movement allows you to get a more three-dimensional shape</li> <li>Treated localization should be exposed and well immobilized</li> </ul>
Reference point	<ul style="list-style-type: none"> <li>Reference point should be on the patient body</li> <li>Radio-opaque markers at reference point (cross points)</li> </ul>



## CONCLUSIONS

Despite the differences resulting from the use of various equipment for patient immobilization, imaging and treatment and the different practice of teams working in distant centers, a unified process was successfully introduced and adopted by all centers.