In the treatment planning of radiation therapy, the positioning and immobilization of the patient established when preparing CT simulation are especially important. For all treatment modalities, a key requirement is to place the patient in a comfortable, reproducible position that enables both irradiation of the target volume with the maximum dose and the greatest sparing of healthy tissue.

In radiation treatment planning of head and neck tumors, the patient is placed in the supine position. As a rule, a head support is provided to achieve a neutral position or, if necessary, the neck is hyperextended. Immobilization of the patient’s head, neck, and shoulders in this position is usually achieved by means of a thermoplastic mask fixed to a base plate secured to the treatment table. Moreover, depending on the type of therapy to be performed, beside these, other immobilization systems can be used, such as the intraoral stent. The arms usually lie along the body, but patients may also be asked to cross their arms over their chest so as to lower their shoulders and reduce the occurrence of “beam hardening artifacts” on CT images.

In mediastinal irradiation, patients lie supine with both arms extended above the head. It is advisable to use personalized positioning and immobilization systems and controlled breathing procedures so as to minimize the geometrical uncertainty of the treatment (vacuum system, T-bar device, Perspex cast).

For treatments extended to the upper abdomen, the patient usually lies in the supine position, and an immobilization system is recommended (e.g., cast or vacuum system). Moreover, for better setup of treatment fields, the arms should be raised above the head.

In some cases of radiation delivery to the pelvic region, the prone position may be considered as an alternative to the supine position. For instance, the supine position is recommended for the treatment of anal cancer and gynecological tumors. On the other hand, rectal cancer requires a prone setup, possibly with the support of systems for displacing the small bowel (especially in the event of preoperative treatment). Radiotherapy of prostate cancer is mostly performed in the supine position, but the prone position has been reported for this tumor as well. Moreover, supports may be placed under the patient’s knees to improve relaxation of the back, hindered by the rigid treatment couch. Since foot displacements can also change the relative position of bony landmarks that are crucial for determining
the accuracy of setup, specific “foot-blocking” supports can also be used.

As for the choice of the prone setup, it should be considered that it favors spontaneous gravitational displacement of the small bowel outside the pelvis. Another condition favoring the prone position is the difficult repositioning of treatment fields on obese patients. The skin marks on the anterior pelvic region of these patients can shift, even by several centimeters, due to the presence of adipose tissue. On the other hand, the posterior skin surface is usually more flat and less mobile, and is therefore more suitable for placing skin marks for treatment. Some obese patients have skin folds in the lower abdomen, which can cause undesirable skin reactions. These skin folds can be carefully reduced if the patient pulls up the pendulous abdomen while acquiring the prone position.

We carried out an interdisciplinary methodology developed in collaboration with radiologists to defined some practical suggestions for the execution of the CT scan for radiation treatment planning (planning CT). The CT scanning technique should be spiral and single-slice, since it affords higher resolution and provides a greater amount of volumetric information for delineation of radiotherapy target volumes compared with sequential acquisition [80, 93, 94]. It is usually performed during free breathing.

In the presence of peripheral lung tumors an optimized version of the above-mentioned procedure may be considered, by acquiring three slow CT scans (4 s per scan) obtained during quiet respiration [95].

Computed tomography includes recording of two scout views: an anteroposterior view and a laterolateral view.

Acquisition volumes for the four main anatomical regions taken into consideration in our experience can be described as follows:

- **Head-neck.** The acquisition volume can be considered to extend from a plane tangential to the upper edge of the dorsum sellae (upper limit) to a plane 2 cm caudal to the upper edge of the sternal manubrium (lower limit).
- **Mediastinum.** The acquisition volume extends from the cricoid cartilage (upper limit) to the L2 vertebra (lower limit) [80].
- **Upper abdominal region.** The acquisition volume extends from a plane located 2 cm above the liver dome (upper limit) to the level of the iliac crests (lower limit).
- **Pelvis.** The upper limit has been established 1 cm cranial to the upper limit of the iliac crests, while the lower limit is located at the level of the ischio-rectal fossae or, in case of rectal cancer infiltrating the anal canal, or cancer of the anal canal, or of the vulva and vaginal canal, at the level of the anal verge.

The main parameters for the execution of CT scans in the different anatomical regions are listed in Table 4.1.

The recommended window settings for best viewing of different tissues of the four anatomical regions are the following:

- **Head-neck.** The window width and window level of CT images for head-neck soft tissues are 350 Hounsfield units (HU) and 35 HU, respectively. The corresponding settings for bone structure analysis are 2,000 HU and 400 HU.
- **Chest.** The appropriate viewing window for the mediastinum has a width of 400 HU and a level of + 40 HU, while for the pulmonary parenchyma the recommended width is 1,600 HU and level is −600 HU [96, 97].
- **Upper abdominal region.** For studying the upper abdominal region, the recommended window level is 40 HU while window width is 350–400 HU.
- **Pelvis.** For soft tissues a width of 400 HU and a level of 40 HU are recommended. For bones, recommended values are the same as for the head and neck region.