17.1
External-Beam Partial Breast Irradiation

External-beam radiotherapy has many advantages over other techniques of partial breast irradiation (PBI) (Formenti 2005, 2007). First and foremost, treatment is given after lumpectomy, when complete pathologic information is available on the original tumor and the status of the resection margins. Second, it spares the patient from the need for a second surgical procedure, since simulation and treatment are performed using a noninvasive method that does not require anesthesia. Third, the technique of external-beam PBI is more likely to be easily reproducible across different radiation oncology centers, since treatment outcomes are less likely to depend on the experience and operative skills of individual oncologists, unlike interstitial brachytherapy or MammoSite treatment techniques. External-beam PBI also generates better dose homogeneity, which may result in improved cosmetic outcome as compared to brachytherapy techniques. Finally, external-beam PBI is more cost-effective and less expensive than brachytherapy techniques (Suh 2005; Ellerin 2004). Considering these theoretical advantages, we developed a partial breast irradiation program that uses prone positioning, originally at the University of Southern California (Jozsef et al. 2000). Over the past eight years, this approach has been studied and defined further at New York University (Formenti 2004). In parallel, a series of different prone boards or prone tables were developed, with the intention of converging daily reproducibility with patient comfort (Fig. 17.1).

17.2
Selection of a Dose Fractionation Scheme for Postoperative Prone EB-PBI

The ease of target coverage in the prone position, without exposure to the heart or lung, together with the treatment of a partial volume of the breast with PBI created the ideal conditions to safely explore an accelerated hypofractionated regimen. By applying the
linear–quadratic cell survival model with an $\alpha/\beta$ value for breast carcinoma of 4 (Barendsen 1982; Steel 1987; el-Fallah et al. 1997), a dose of 30 Gy given in five fractions of 6 Gy over ten days was found to be radiobiologically equivalent in tumor control to a dose of 50 Gy given in 25 fractions of 2 Gy over five weeks, as used in most breast cancer studies of the National Surgical Adjuvant Breast and Bowel Project (Fisher 2002). At the time of the original trial design, the question of the appropriate $\alpha/\beta$ value for breast cancer was the focus of lively debate within the breast cancer radiotherapy research community, with many supporting the adoption of an $\alpha/\beta$ of 10 for breast cancer. Based on available preclinical and clinical indications, in 2004 we conducted an analysis of the biologically equivalent doses of different fractionation schemes (Table 17.1a and b) (Rosenstein et al. 2004). Recently, the results from the randomized UK START A trial confirmed in a larger series of patients that the $\alpha/\beta$ value of 4 for breast cancer was a prescient and accurate estimate by confirming in the clinic what we had originally predicted based on preclinical models (Bentzen 2008).

17.3 Rationale for Patient Selection Criteria for Postoperative Prone EB-PBI

The ongoing randomized trial sponsored by the National Surgical Adjuvant Breast and Bowel Project and Radiation Therapy Oncology Group, NSABP-39/RTOG 0413, compares partial breast to whole breast radiation. Eligible for this trial are women with Stage 0, I, and II breast cancers under 3 cm in size and with less than three axillary lymph node metastases. Results from this trial that will allow the optimal selection of patients for whom partial breast treatment is most appropriate are not yet available. Moreover, in the absence of proven equivalence at an adequate long-term follow-up, partial breast irradiation remains investigational and should be made available only in the context of a clinical trial.