The value of three-dimensional (3D) planning and conformal radiotherapy in the treatment of soft tissue sarcoma has already been established [1]. In a previous volume on soft tissue sarcomas in this series (Cancer Treatment and Research), Suit and Willett succinctly described the sequential steps required for optimal radiation therapy [2]. Alternatives to external-beam radiotherapy, including intraoperative brachytherapy and proton beam therapy, were highlighted, although such techniques are applicable in only a minority of situations. Fast neutron therapy offers no proven advantage and may lead to excessive morbidity [3].

The ideal dose of radiation is that which reliably eradicates all tumor but does not result in unacceptable normal tissue damage [4]. For any given tissue, the volume irradiated is the single most important factor leading to normal tissue morbidity and will limit the total dose that can be applied; this, in turn, relates to the probability of local control, because a dose-response relationship has been established [5]. The target volume varies according to whether the treatment is being given preoperatively or postoperatively, and according to the size, site, and grade of the primary tumor. A shrinking field technique is invariably recommended in order to minimize the highest dose volume. This volume is most critical when treating sarcomas arising in the head and neck [6], tumors arising in the retroperitoneum [7], and soft tissue sarcomas of children [8]. It is also particularly crucial when re-irradiation is contemplated [9].

A preoperative magnetic resonance (MR) scan is the most valuable investigation to assist with definition of the target volume. A computed tomograph (CT) scan may provide almost as much information but all too often neither is available because the original operation was undertaken without the diagnosis of sarcoma having been considered. In all cases, assessment of the extent of tumor is of paramount importance and should be discussed with the surgeon. A written copy of the operative procedure must be obtained, together with the histopathology report describing the macroscopic and microscopic appearances, including the margins of resection (a wider re-excision may be recommended). Postoperatively a diagnostic CT scan may be necessary to confirm
complete excision of tumor or the extent of residual tumor; MRI may be difficult to interpret postoperatively if edema or seroma is present. A therapy CT planning scan will be required in all cases requiring radiotherapy for accurate dosimetry.

Not to be underestimated in the definition of the optimal target volume is the anatomical position of the part of the body to be treated. For example, when treating the forearm, consideration must be given to whether the position should be prone or supine, depending on the site and extent of the tumor, together with the directions of the potential extension. Careful patient positioning is also valuable in ensuring a corridor of normal tissue sparing as well as maximal exclusion from the treatment volume of adjacent joints. An example is inclusion of a surgical scar in the region of the elbow: If this is either medially or laterally placed, then the arm is preferably treated with the elbow fully extended. Whereas if the scar runs centrally over the antecubital fossa, then it is preferable to treat with the elbow flexed at 90° and the hand on the hip to spare the region around the olecranon. All these anatomical considerations need to be made and the optimum patient position decided on prior to acquisition of the therapy CT scan.

Reproducible patient immobilization is a further prerequisite for conformal radiotherapy and must also be devised prior to the therapy CT scan. If a perspex shell is used, care should be taken to avoid treatment fields passing through the shell, unless a high dose is required to be administered to the skin. A careful decision needs to be made as to the optimal method of immobilization, which will vary with the anatomical site.

Extremely long fields are frequently necessary, but it is preferable to treat at an extended distance than to match isocentric fields, even if these are matched at the isocenter at an area not grossly involved with tumor, as suggested by Dusenbery et al. [10]. In order to shield adjacent normal tissues, simple beam blocking is adequate in some situations. Frequently, however, complex shaping of the volume will demand conformal treatment, and 3D planning is the best method for achieving this. The multileaf collimator is the ultimate method of achieving elegant beam shaping in a quick, accurate, and reproducible manner. Together with the use of a dynamic wedge, it may also reduce the incidence of cumulative trauma disorder in radiation therapists/radiographers [11].

Advantages of three-dimensional planning

The objective of three-dimensional planning and conformal radiotherapy is precise and reproducible treatment of the defined target volume with maximal avoidance of adjacent normal tissue. Its major advantage is in avoiding or at least minimizing normal tissue damage, both acute and, more importantly, late normal tissue damage. Historically, relatively little attention has been given to the technique for treatment of soft tissue sarcomas, partly because the vol-