Tumors in the head and neck are treated in the majority of cases by surgery and/or radiation therapy (RT). If the primary cancer is irradiated, conceptually a high dose of RT is to be given, particularly if one is dealing with large T3 or T4 tumors. The RT can be given by external beam irradiation (ERT) or interstitial radiation therapy (IRT). In the Dr. Daniel den Hoed Cancer Center (DDHCC), patients with deep-seated advanced and/or recurrent tumors in the head and neck are in some instances treated by a combination of ERT and (subsequent) IRT (LEVENDAG et al. 1992). When using IRT, high tumoricidal doses of RT can be applied while attempting to compromise the surrounding normal tissues as little as possible. Unfortunately, when RT doses in the order of 70-80 Gy are applied, failures do occur even if the RT is tailored to the primary cancer to the greatest extent possible by means of interstitial techniques; moreover, the side-effects of such high doses of RT can be substantial.

With a view to increasing tumor cell kill and decreasing the incidence of side-effects, we embarked on a pilot study in which the IRT is combined with interstitial hyperthermia (IHT); by taking advantage of the additive and/or synergistic effects of hyperthermia, it is hoped that the therapeutic ratio will eventually be improved. The pilot study was initiated in 1988; the main aim of the study was to see whether hyperthermic temperatures (41°-43°C) could be safely achieved in deep-seated tumors when using the 27-MHz capacitive coupling interstitial hyperthermia system that was developed at the DDHCC (VISSER et al. 1989; DEURLOO et al. 1991).

27.2 Materials and Methods

27.2.1 Patient Selection

All newly admitted patients with tumors in the head and neck region are jointly seen by the members of the Rotterdam Head and Neck Cooperative Group once weekly. Patients with advanced and/or recurrent tumors not eligible for standard treatment can enroll in a number of experimental treatment protocols. For example, if brachytherapy is considered (technically) feasible for adequate coverage of the primary and/or regional tumor areas, then a combined modality treatment protocol as part of a nonrandomized pilot study using surgery, ERT and IRT + IHT is an option. This pilot study is now closed for entry, and the present report reviews the available data.

In 11 patients with very advanced and/or recurrent tumors the brachytherapy used for the primary cancer was combined with IHT (Figs. 27.1, 27.2). The total treatment scheme consisted of surgery of the neck (n = 6), ERT to the primary tumor and the neck (n = 9; 46–50 Gy), and a combination of IRT (n = 11; minimum tumor dose 20–66 Gy) plus IHT...
27.2.2 The 27-MHz Capacitive Coupling IHT System

The 27-MHz capacitive coupling IHT system has been described in detail elsewhere (Visser et al. 1989; Deurloo et al. 1991). A schematic view of the interstitial hyperthermia system is shown in Fig. 27.3. In short: Each applicator is connected to its own generator (27.12 MHz, maximum output of 10 W, SSB Electronic, FRG) by a coaxial cable. A variable air coil is used for impedance matching. To minimize cross-talk between applicators, isolation transformers are included. The present system consists of 12 generators (Fig. 27.3).

A schematic representation of the applicator is depicted in Fig. 27.4. These applicators are constructed of thin flexible catheters (ID = 0.86 mm, OD = 1.27 mm) partly covered by a conducting paint (Acheson, type Electrodag 1415) (Fig. 27.4). When using this design, the applicators can be easily inserted in standard nylon brachytherapy catheters (ID = 1.5 mm, OD = 2.0 mm).

Due to the “high” frequency (27 MHz) there is an effective capacitive coupling, through the nylon implanted catheter, between the painted segment of the applicator and the surrounding tissue. Electric current can flow to an external groundplane, which is coupled to the tissue through a bag of saline. Through absorption of the electromagnetic energy the tissue is heated. The length and the position of the heated region can be freely chosen. Due to the high impedance associated with the capacitive coupling, the applicators can be seen as current sources (Deurloo et al. 1991). The current along