

## On Science and Scientists

"I have been developing an ethic for science which derives directly from its own activity. It might have seemed at the outset that this study could lead only to a set of technical rules: to elementary rules for using test tubes, or sophisticated rules for inductive reasoning. But the inquiry turns out quite otherwise. There are, oddly, no technical rules for success in science. There are no rules even for using test tubes which the brilliant experimenter does not flout; and alas, there are no rules at all for making successful general inductions. This is not where the study of scientific practice leads us. Instead, the conditions for the practice of science are found to be of another and an unexpected kind! Independence and originality, dissent and freedom and tolerance: such are the first needs of science; and these are the values which, of itself, it demands and forms."

"Science is not a mechanism but a human progress, and not a set of findings but the search for them. Those who think that science is ethically neutral confuse the findings of science, which are, with the activity of science, which is not. To the layman who is dominated by the fallacy of the comic strips, that science would all be done best by machines, the distinction is puzzling. But human search and research is a learning by steps of which none is final, and the mistakes of one generation are rungs in the ladder, no less than their correction by the next. This is why the values of science turn out to be recognizably the human values: because scientists must be men, must be fallible, and yet as men must be willing and as a society must be organized to correct their errors. William Blake said that 'to be an Error & to be Cast out is a part of God's design.' It is certainly part of the design of science."

J. Bronowski, *Science and Human Values with the Abacus and the Rose*. New York and Evanston: Harper & Row, 1965. pp. 62-64.

## Radiotherapy in the Management of Oral Cancer\*

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Radiotherapy and surgery, used singly or in combination, are the only curative approaches to the treatment of mouth cancer. Preoperative irradiation of advanced cancer is now being evaluated, and shows much promise. This may permit operation in previously inoperable cases, make less extensive operative procedures feasible in others, and possibly decrease the incidence of cancer spread during surgery. However, while surgery often can salvage radiation failures, the reverse is seldom true.

### Surgery and Radiotherapy in Oral Cancer

Among surgeons acquainted with the capabilities of good radiotherapy, and radiotherapists familiar with good oral surgery, one seldom finds major differences of opinion about the management of individual cases.

Each method has its advantages and disadvantages. Any acceptable method of treatment must have a good cure rate, a low incidence of complications, and should terminate in the best possible functional and cosmetic result. This last criterion is the least important, but makes radiotherapy of special interest in treating cancer of the mouth. In instances where either method might have equal chances of cure or complication rates, a method that would not interfere significantly with function and appearance is preferable. A normally functioning and normally appearing mouth may not be essential for life, but it is important to the enjoyment of life in our society.

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### Cancer of the Lip

Cancer of the lip usually is easily managed by radiotherapy. Its accessibility facilitates the evaluation of the progress of treatment. Shielding adjacent areas from the x-ray beam is easily done, and the results in properly selected and treated cases should be uniformly good. This does not mean that surgery is never indicated. When leukoplakia coexists and can be removed along with the cancer, surgery generally is preferred. The irradiation of lip cancer, be it new or recurrent, near or at the site of previous intensive irradiation, is to be avoided since overlapping these areas invites soft tissue necrosis. The presence of regional lymph node metastasis often will make it desirable to excise these in continuity with the primary lesion. In extensive cases, invasion of the mandible is regarded as a relative contraindication to irradiation since this predisposes to failure and osteonecrosis.

### Cancer of the Buccal Mucosa

In early cancer of the buccal mucosa, surgery and irradiation give about equal cure rates, but radiotherapy generally results in a better functional and cosmetic result. Surgery is preferred for the more advanced fixed ulcerating tumors, particularly those with mandibular involvement or regional node involvement; they are seldom cured by irradiation.

### Cancer of the Tongue

The inaccessibility of carcinoma of the base of the tongue dictates treatment by radiation therapy. The results in squamous cell carcinoma are poor. Metastases to the regional nodes are common, and often bilateral. Irradiation seldom will sterilize these. Furthermore, these lesions generally infiltrate deeply, and control of the primary site is achieved rarely. Occasionally, lymphomas are encountered in this region. Their prognosis is much better because they are considerably more radiosensitive.

Tumors of the lateral margin of the tongue, and the occasional lesion of the dorsum of the tongue, present a more optimistic outlook for the radio-

therapist. A significant percentage of these cases can be treated successfully with little functional impairment. Among the lesions to be avoided by the radiotherapist are those with pre-existent syphilitic glossitis, those with marked sepsis and edema of the tongue, those which have been previously irradiated, and the extensive lesions with mandibular involvement.

The anterior third of the tongue can be treated by surgery or irradiation. Excision of this portion seldom produces any significant functional impairment, and surgery often is more expedient.

The inability of ionizing radiation conclusively to cope with metastases to regional lymph nodes from squamous cell carcinoma of the oral cavity has already been indicated. Since approximately 80% of patients with cancer of the tongue already have or will develop node metastases (Ackerman and del Regato, 1954), a neck dissection, either prophylactic or for clinically evident disease, usually is a part of the treatment.

### Cancer of the Floor of the Mouth

Cancer of the floor of the mouth responds well to radiotherapy if the mandible is not involved and there is no lymph node metastasis. Even in the presence of node metastases, it often is feasible to irradiate the primary site and do a neck dissection, thus saving the jaw. When cancer of the floor of the mouth involves the mandible, with or without nodes, curative therapy becomes a surgical problem. The same general considerations apply to lesions of both the upper and lower gingiva.

### Malignancy of the Soft and Hard Palates, Salivary Glands, and Tonsils

Lesions of the soft palate should be managed by radiotherapy wherever possible since extensive surgical procedures in this region generally result in considerable disability in swallowing and talking. Lesions of the hard palate are more often handled surgically since surgical defects in this region usually are corrected easily with a proper prosthesis. Adenocarcinomas arising from the minor salivary glands are common in this region and, in

general, are not as radiosensitive as the more common squamous cell carcinomas.

Squamous cell carcinoma is the commonest type of malignancy encountered in the tonsil, but lymphosarcoma is not unusual and reticulum cell sarcoma and Hodgkin's disease occasionally are seen here. Irradiation as the primary treatment is usually the choice in each of these instances. The majority of these patients show cervical lymphadenopathy at the time treatment is instituted. While the nodes are included in the field of treatment, radical neck dissection may be necessary following irradiation of the squamous cell carcinoma. The lymphomas, being much more radiosensitive, seldom will need a neck node dissection.

### Problems of Oral Hygiene

When radiotherapy is selected for treating cancers of the oral cavity, the preparation of the mouth for this treatment becomes one of the most important aspects of the therapy. It is often necessary to include the salivary glands in the treatment portals. This causes a temporary suppression of their activity that, depending upon the dose, lasts for varying lengths of time. With the high doses employed in the treatment of squamous cell cancer, the dryness usually persists for several months and the normal flow of saliva seldom is completely regained. A permanent alteration in the chemical and physical characteristics of the saliva occurs. This presumably causes the rapid acceleration of dental caries which is common after irradiation. This type of caries is somewhat peculiar in that the decay occurs at the gingival margin, and the most particular mouth hygiene does not seem to prevent it.

In addition to dental caries, irradiated bone heals poorly and is subject to bacterial invasion. Whenever extraction of teeth from irradiated bone becomes necessary, there is a high risk of a chronic, intractable osteomyelitis of this partially devitalized bone. All radiotherapists do not agree on this point, but most anticipate these possible complications and attempt to avoid them by having extractions done prior to irradiation.

This type of tooth extraction should not be looked upon as routine. Speed is important so that treatment is not delayed. The teeth should be removed in as few sittings as possible. If this is done, with all rough spicules of bone rongereured away carefully, and the gums carefully sutured, normal healing usually results; it is seldom necessary to delay the institution of therapy for more than a few days. When the salivary glands are not to be treated, only diseased teeth and those to be in the beam need be extracted.

#### Selection of Radiotherapeutic Procedure

There are many methods of administering radiation therapy to the mouth, and practically every technique has some area of preferred use. Telecobalt and megavoltage are being used in most radiotherapy centers today; however, they have not, and will not, completely replace conventional x-irradiation, radon, and radium.

Conventional orthovoltage x-ray is most useful in accessible lesions, such as the lip or buccal mucosa, and in the occasional small lesion that can be treated with an intraoral cone. As previously mentioned, shielding normal structures from this type of irradiation usually is done easily, while shielding from supervoltage is quite difficult.

Megavoltage irradiation and telecobalt are most useful in the less accessible lesions where it is necessary for the radiation to penetrate bone in order to reach the tumor. Because photoelectric absorption is much less with these modalities, the energy absorbed by the bone is considerably less than it would be from a beam of conventional x-ray; there also is less shielding of the lesions by the bone. A better tumor dose is achieved with a lower given dose, and there also is a significant decrease in skin effect as the maximum ionization occurs subcutaneously.

Radon seeds, interstitial radium implants, and radium molds have the advantage of localizing the radiation to the area treated. Little radiation reaches other sites. This radiation is of a quality comparable to megavoltage and telecobalt, and it has the same

bone sparing effect. Radon seeds are used primarily in small tumors which are easily accessible for implantation, such as the buccal mucosa, floor of the mouth, soft palate, or tongue lesions. Interstitial radium needles find their place in the larger, deeper seated tumors of the tongue, floor of the mouth, and buccal mucosa. They are used often with external irradiation. Radium molds can be very useful in areas where they can be made to fit properly, such as the gingiva, hard palate, and floor of the mouth. Some radiation centers treat lip cancers almost routinely by sandwiching the lip between two radium molds. In experienced hands, this gives a very nice cosmetic and functional result. The use of molds by an inexperienced operator is not recommended as they must be properly applied and fitted to do the job well.

A more recent and little-explored radiotherapeutic method of cancer treatment is that of electron beam therapy. The dose from an electron beam is nearly constant to a depth corresponding to the range of these electrons in tissue, which in turn depends upon the accelerating voltage of the machines. With the use of electron beam therapy, the deeper tissues can be spared almost completely from radiation effect, thus reducing complications, discomfort, and the difficulties in maintaining nutrition during and after treatment.

#### Complications of Radiation Therapy

The most serious complications of radiation therapy in the treatment of oral cancer are osteonecrosis and osteomyelitis. The advent of megavoltage x-ray and telecobalt has helped greatly to diminish the incidence of these complications, but has not eliminated them. Effective treatment of cancer in any site requires radical treatment, and radiotherapy is no exception. Any method carrying a high incidence of complications is not a good one, but when complications never occur, it usually is at the expense of undertreating.

The dryness of the mouth that occurs when the parotids are irradiated, the aberrations in taste when the tongue is treated, and the membranous reactions of the mucous membranes in

the treated areas are troublesome, but should not be looked upon as complications. All possible attempts should be made to minimize these reactions, but usually they cannot be avoided completely.

In a paper given to the American Radium Society, Ash (1962) presented 5-year results on 1,624 patients treated at the Ontario Cancer Institute, representing a 96% follow-up. The crude 5-year survival rates were given in detail by site and stage for cancer of the tongue, buccal mucosa, gingiva, floor of the mouth, and palate. The treatment policy primarily was radiotherapy, with cervical metastasis being managed by radical neck dissections. The overall 5-year results for all sites and stages was 31.5%. These results are typical of what can be expected today with good radiotherapy. Carcinoma of the lip and tonsil were not included in these figures. The tonsil should yield a 30 to 40% 5-year survival, and the lip about 80%.

Whatever definitive form of therapy is used on any given case of oral cancer, one point seems worthy of emphasis. This disease involves many specialties in the field of medicine. For this reason, a team approach to its treatment is desirable. The dentist, the pathologist, the surgeon, and the radiotherapist all have definite contributions to make. Consultation among them prior to the treatment generally will be to the patient's advantage.

#### References

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