Paparella: Volume III: Head and Neck

Section 2: Disorders of the Head and Neck

Part 7: The Neck

Chapter 47: Skin Cancer of the Head and Neck

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Skin cancer is the most common malignancy in humans. It is estimated that there are more than 500,000 cases in the USA annually. The vast majority of these tumors arise on the sun-exposed regions of the head and neck. Basal cell carcinoma (BCC) is the predominant histologic type and accounts for about 90 per cent of all cutaneous neoplasms in the head and neck region. Second in incidence is squamous cell carcinoma (SCC). The major portion of this chapter is devoted to a discussion of these two neoplasms, their precursors, and other associated epidermal neoplasms. Because of its distinct biologic behavior, malignant melanoma is addressed as a separate entity in Chapter 48. The more unusual skin tumors, benign and malignant, are not discussed specifically, but many of the principles outlined concerning the evaluation and treatment of cutaneous cancers are applicable.

Risk Factors

The risk factors for both BCC and SCC are strikingly similar. These lesions are most often encountered in patients aged 60 years or older, although they can certainly occur in younger age groups. Not surprisingly, there is a trend toward increasing incidence in younger patients as the tanning-conscious generation comes of age.

It is well known that sun exposure is the most important causative factor in the development of skin cancer. The evidence for this cause and effect relationship has been summarized by Gordon and Silverstone (1976): (1) more than 90 per cent of skin cancers are on exposed parts of the body, (2) skin cancers are seen more commonly in people with outdoor occupations, (3) the amount of skin pigmentation affects the incidence and prevalence of skin cancer, (4) there is a direct relationship of incidence and prevalence to geographic latitude, and (5) it has been shown experimentally that specific wavelengths of ultraviolet light will induce skin tumors in laboratory animals.

The mechanism by which ultraviolet light causes sun-damaged skin has been extensively studied. Laboratory experiments indicate that the wavelengths with the most potential for carcinogenesis are those in the 280 nm to 320 nm range, the ultraviolet B-band or UV-B. This same band of light is responsible for the common sunburn (Robertson, 1982). The transition from normal to actinic (sun-damaged) to cancerous skin is usually a slow progressive process that generally occurs over several decades.

It should be stressed that the carcinogenesis of epidermal tumors parallels that of other neoplasms; it is the result of an interaction of numerous factors. Just as with other neoplasms, there are certain characteristics that will make the host more susceptible to the development of a cancer. Traits associated with an increased incidence of skin cancer include fair

complexion, light hair, blue or green eyes, inability to tan, propensity to sunburn, history of multiple or severe sun burns, and Celtic origin (Gordon and Silverstone, 1976; O'Rourke and Emmett, 1982). Other factors implicated include age, occupation, and geographic residence. These are generally considered indirect causes of increased sun exposure.

There are other causative agents that are also associated with the development of cutaneous carcinoma (O'Rourke and Emmett, 1982). Chronic exposure to chemical agents, such as arsenic, has been shown to be associated with the development of multiple squamous and basal cell tumors. Unfortunately, arsenic in the form of Fowler's solution has been used for many years to treat asthma, hay fever, and psoriasis (Swanson and Grekin, 1986). Patients with chronic radiodermatitis related to previous superficial irradiation therapy have been shown to have a propensity for the development of multiple or aggressive lesions, or both. Trauma in the form of burns, ulcers, and scars is also associated with the development of skin cancer. Immunosuppression, such as in transplant patients, those on chemotherapy, or those with leukemia and lymphomas, can be complicated by the increased incidence or aggressiveness of skin malignancies. Genetic syndromes such as xeroderma pigmentosum (autosomal recessive trait) and nevoid basal cell carcinoma syndrome (autosomal dominant trait) are both associated with a predilection for the development of multiple BCCs, often at an early age.

Basal Cell Carcinoma

Clinical Types

There are several clinical types of BCC that have been identified. Lever and Shaumberg-Lever (1983) have outlined five clinical forms, which include (1) nodular or noduloulcerative, (2) pigmented, (3) morphealike or fibrosing, (4) superficial, and (5) fibroepithelioma. The most common of these is the *nodular* or *noduloulcerative* lesion. This typically presents as a discrete, raised, circular lesion that is pinkish and waxy, with a capillary network that is easily visible. There is often an area of central ulceration, and the border of the lesion is rolled. This is generally recognized as the type of BCC that is easiest to recognize and treat. (Similar to this lesion is the cystic BCC, which is also waxy and well demarcated but is more cystic in appearance.) *Pigmented* BCC is characterized by its brown pigmentation and may resemble a pigmented nevus or a melanoma. The appearance and behavior of this lesion seem to parallel those of nodular BCC. In *superficial* BCC, the lesion shows evidence of scarring and atrophy with a thin, threadlike, waxy border. This lesion may consist of one or several red, scaling patches. These crusted patches have irregular borders and gradually increase in size by peripheral extension. They are relatively uncommon in the head and neck and more frequently occur on the trunk or extremities. *Fibroepitheliomas* present as firm pedunculated lesions, resembling fibromas. They commonly occur on the back.

The most vicious and deceptive type of BCC is the *morphea* type, also called sclerosing or fibrosing BCC. This variety is typified by its macular whitish or yellowish plaque. Some authors have noted an increased incidence in women. The margins may be quite indistinct, and the lesion may go unnoticed for years in some patients. The lesion may be scarlike, may develop telangiectasis, or may ulcerate.

The *nevoid BCC syndrome* is an autosomal dominant disease. During childhood, small cutaneous nodules appear, often numbering in the hundreds. These lesions initially have a rather indolent course during the nevoid phase, but as the patient gets older, a neoplastic phase may occur, in which the lesions show a marked change in aggressiveness. The lesions then may become invasive, destructive, and mutilating. Associated abnormalities include jaw cysts, bifid ribs, scoliosis, mental retardation, and frontal bossing.

Histopathological Features

The characteristic cell in BCC has a large oval or elongated nucleus with relatively little cytoplasm. These cells may resemble the basal cells of the epidermis, but the neoplastic cells lack intercellular bridges. The nuclei are usually rather uniform in size and configuration. A connective tissue stoma proliferates with the tumor and is arranged in parallel bundles around the tumor masses. Often the stroma may be mucinous. Since mucin shrinks with dehydration and fixation of the specimen, the stroma may show retraction from the tumor islands. This detachment of tumor islands from the stroma is known as clefting and can be a helpful sign in the diagnosis of BCC.

Lever and Schaumburg-Lever (1983) have divided BCC into four basic histologic patterns: solid, keratotic, cystic, and adenoid. In the solid pattern, the cells show no differentiation. This type generally displays tumor masses of various sizes and shapes embedded in the dermis. The peripheral cell layer often shows a palisade arrangement of the nuclei.

Those BCCs with a differentiation toward hair structures are referred to as keratotic. This lesions is typified by undifferentiated cells in combination with parakeratotic cells and horn cysts. Cystic tumors show differentiation toward sebaceous glands. Histologically, there may be one or several cystic spaces within tumor lobules. In the adenoid variety of BCC, the tumors display a tubular or glandular formation. The strands of epithelial cells commonly form a lacelike pattern.

Keratotic Basal Cell Carcinoma

Keratotic BCC, also known as basosquamous cell carcinoma or metatypical carcinoma, has been the subject of much controversy. The confusion arises because there are histologic features of both BCC and SCC that coexist in the same lesion. Thus, the debate has been over the prognosis and behavior of such a lesion. It now appears that most dermatopathologists feel that this basosquamous tumor is a variant of BCC, referred to by many as keratotic BCC (Lever and Schaumburg-Lever, 1983). Although there appears to be a limited potential to metastasize, keratotic BCC is felt to be more biologically aggressive than many of the other types of BCC.

Actinic Keratoses

Actinic keratoses (solar keratoses) are extremely common lesions seen almost exclusively in sun-exposed areas of the skin. The lesions are generally less than 1 cm in diameter and are commonly seen on the face, scalp, hands, and forearms. They are considered to be precancerous. The chance of progression to epidermal cutaneous carcinoma has been

estimated to be as high as 20 per cent (Lever and Schaumburg-Lever, 1983). Clinically, they usually present as an erythematous patch, often covered by an adherent scale. They show little or no sign of infiltration. Occasionally there is a marked element of hyperkeratosis, giving the clinical appearance of a cutaneous horn. Since these lesions have the potential to transform into a malignancy, most feel that they should be treated. Depending upon the clinical setting, excision, cryosurgery, or topical treatment with 5-fluorouracil may provide effective treatment.

Bowen's Disease

Bowen's disease is considered a preinvasive form of SCC. It can be considered synonymous with carcinoma in situ of the skin. Histologically, there is full-thickness dysplasia of the epidermis, although there is no evidence of invasion. Clinically, the lesion presents as a well-circumscribed, erythematous, scaly patch or plaque with an irregular border. As with squamous cell carcinoma, these lesions generally occur in sun-exposed areas. They are particularly common in patients with a history of chronic arsenic ingestion, in whom lesions often occur on nonexposed skin. The lesion may resemble a superficial BCC, but it lacks the fine pearly border.

Keratoacanthoma

Keratoacanthoma must be mentioned here, as it may be easily confused with SCC, particularly histologically. It is more common in men and typically presents in older patients. There is a history of rapid growth, usually over a 2- to 6-month period. The lesion begins as a smooth, rounded nodule, but with further enlargement the center becomes ulcerated and filled with keratinous material, taking on a volcanolike appearance. The hallmark of keratoacanthoma is the history of rapid growth over weeks to months. The most common site affected in the head and neck is the nose. Although histologically the lesion resembles an SCC, it may involute spontaneously leaving only a depressed scar. Despite this, surgical excision is recommended, as the exact course and behavior of each lesion is difficult to predict.

Squamous Cell Carcinoma

Clinical Types

SCC is less common than BCC but still accounts for about 10 per cent of skin malignancies. As with its counterpart, SCC is related to chronic long-term sun exposure, usually of at least 10 to 20 years' duration. in fact, as one approaches the equator, the relative incidence of SCC to BCC increases. Cutaneous SCC, like BCC, is more common in men.

SCC of the skin generally presents as an erythematous, ulcerated, crusting lesion. The tumor often demonstrates a granular base, which may be friable and tends to bleed with minimal trauma. There is usually an elevated area of induration at the lesion's edge, and there may be an inflammatory response in the adjacent tissues.

Just as with BCC, these lesions may present in different clinical patterns. SCC can present as a thickened *hyperkeratotic patch* or area of crusting. Once this crust is removed, there is often an ulcerated base with a rolled margin.

Other lesions may be recognises as areas of *persistent ulceration.* This may be in an area of previous trauma, burns, or an old scar. Neoplastic change in a chronic ulcer may result in either BCC or SCC and is associated with a poorer prognosis.

Superficial multifocal lesions can arise in actinic skin. These lesions are usually accompanied by a scaling patch that bleeds with minimal trauma. Diagnosis and determination of the extent of the lesion can be difficult, and multiple biopsies may be necessary.

Occasionally, SCC may present as a *nodular,* exophytic lesion. It may initially seem cystic but later tends to become ulcerative and progressively enlarges. These lesions may also demonstrate a sudden spurt of growth (Harris, 1982).

Histopathologic Features

Several histologic characteristics are important when analyzing SCC. The usual histologic picture of SCC of the skin is that of irregular masses of epidermal cells that proliferated downward and invade the dermis. The tumor masses may be well differentiated or may show atypical or anaplastic cells. More differentiated tumors tend to be associated with evidence of keratinization, such as keratin pearls. Tumors are graded from 1 to 4 using Broder's classification, with grade 1 tumors being well differentiated and grade 4 tumors being poorly differentiated.

There appears to be an important distinction to be drawn as to whether SCCs are actinically induced or arise de novo. Lesions arising in sun-exposed areas appear to follow a more benign course, with a low incidence of metastases. The de novo lesions tend to be more aggressive in their behavior and exhibit a greater potential for metastatic spread. One study has estimated that at least 8 per cent of patients with de novo lesions will experience regional or distant metastases (Jansen and Westbrook, 1981). It is often possible to make the distinction clinically between these two types of SCC (actinic versus de novo). Histologically, a determination can usually be made, looking for actinic changes in the skin adjacent to the SCC.

The histologic variations of SCC have been categorized into five groups: generic, adenoid, bowenoid, verrucous, and spindle-pleomorphic types (Headington, 1979). The generic type is characterized in the previous description of the histopathologic features of SCC. In the adenoid type, there is a pseudoglandular arrangement. These tubular or alveolar formations result from dyskeratosis and subsequent acantholysis. The lumina are lined with one or several layers of epithelium and are filled with desquamated acantholytic cells. The bowenoid type of SCC occurs when there is evidence of invasion coexistent with the findings of Bowen's disease.

Verrucous carcinoma is seldom seen as a skin neoplasm in the head and neck but is well known as a tumor of the oral cavity and larynx. It presents clinically as a whitish cauliflower-like lesion. The tumor is well differentiated, demonstrating hyperkeratosis, parakeratosis, and acanthosis. Clinical and pathologic correlation is needed to confirm the diagnosis.

In the spindle-pleomorphic type of SCC, there is little evidence of differentiation. These tumors are anaplastic, show little if any keratinization, and are usually considered to be a Broder's grade 4 tumor. The spindle cells are intermingled with collagen, may be arranged in whorls, and can be associated with pleomorphic giant cells.

Tumor Behavior and Prognosis

There are multiple factors that have an impact on the behavior, pattern of spread, and ultimate prognosis of these cutaneous malignancies. Certainly the clinical and histologic type is a significant prognostic variable. The morpheaform type of BCC is well known for its "subversive attitude". This lesion generally spreads centrifugally by way of fingerlike projections of tumor. It is deceptive in its behavior and can be difficult to evaluate and control. Likewise, keratotic (basosquamous) and recurrent BCCs are associated with a worse prognosis.

Squamous cell lesions can be virulent as well. They have the potential to metastasize to regional nodes and are sometimes associated with distant metastases. Locally, these tumors are more likely to grow in a vertical fashion and are less likely to respect the barriers of cartilage and bone than is BCC.

The anatomic location is an important variable in considering prognosis. It is widely accepted that various regions of the head and neck have a propensity for recurrence. The nose and ear are sites noted to have a higher rate of recurrence. One factor relating to this phenomenon is the association of recurrence with embryonic fusion planes (Panje and Ceilley, 1979). These embryologic sites of fusion afford greater access for tumors that use these planes as avenues of spread. The most notable sites include the pre- and postauricular regions, the floor of the nose and columella, and the nasolabial crease. The periorbital region is also at risk for tumors tracking along the bone or periosteum, particularly at the medial canthal region. Koplin and Zarem (1980) found the nose to be the most likely target for recurrent basal cell carcinomas. Although the incidence for nasal involvement was 25 per cent for primary BCC, 40 per cent of the recurrent lesions involved the nose. In this series of 164 recurrent BCCs, the nasal, malar, and periorbital areas were involved in 75 per cent of the cases.

Recurrent Cutaneous Lesions

A recurrent carcinoma of the skin presents a much more difficult problem than does its predecessor. Recurrent cancer signifies either inadequate initial therapy or a recrudescence of disease in the tissue adjacent to the original lesion. Depending upon the specific lesion and the site of involvement, the management of the recurrence may be simple or complex. Some lesions may required extensive evaluation and radical treatment. As mentioned previously, the location of a lesion in or near an embryologic fusion plane can influence its behavior and recurrences tend to involve these sites. Most authors report that the most common sites for recurrence are located in the midfacial areas (Mora and Robins, 1978; Levine and Bailin, 1980; Roenigk et al, 1986).

In their review, Levine and Bailin (1980) evaluated 496 cases of recurrent BCC in an attempt to identify significant risk factors. They found the midfacial region was involved in

57.6 per cent of the cases, and the auricular and preauricular areas accounted for 13.4 per cent of the recurrences. The distribution of these recurrent tumors are shown.

Jackson and Adams (1973) described 33 cases of "horrifying basal cell carcinoma". These lesions generally exhibited one or more of the following characteristics: they were large (> 3 cm), destructive, locally uncontrollable, or metastatic. In defining the predominant characteristic of each lesion, the authors found that 13 were large, 6 were destructive, 5 were locally uncontrollable, and 4 were metastatic. They concluded that these "horrifying" tumors usually had an onset before age 40 years, recurred more than twice despite seemingly adequate treatment, and each recurrence was more aggressive that the preceding tumor. In many patients there were underlying conditions that predisposed them to cutaneous BCC, and they included arsenic ingestion, nevoid basal cell syndrome, pre-existing burns, and radiodermatitis.

Levine (1983) has studied the pathogenesis and treatment of large recurrent cutaneous neoplasms. These advanced lesions were termed *massive or previously uncontrolled.* The author included lesions meeting one or more of the following criteria: (1) greater than 3 cm, (2) involvement deeper than skin and subcutaneous fat, (3) four or more previous treatments without control, or (4) proven metastatic disease.

In this series of 60 patients, there were 40 patients with BCC and 20 patients with SCC. Characteristic of this group of lesions was involvement of deeper tissues, with 53 tumors involving salivary gland or muscle, or both. Twenty-nine of these tumors also involved cartilage or bone, or both, with two having intracranial extension. All had had at least one previous attempt at tumor control, and 24 patients (40 per cent) had tumors that persisted or recurred after four or more previous attempts. There were six patients (10 per cent) with regional nodal disease (five patients) or distant metastases (one patient).

The management in this group of patients included the use of Mohs' histographic surgery. This was used either preceding or following conventional surgery, depending upon the location and extent of the tumor. This treatment regimen resulted in 53 (88 per cent) patients who were disease-free with a follow-up of 12 to 48 months. It was the author's conclusion that these massive or uncontrolled lesions are best treated with total microscopic marginal control (Mohs' technique) and that this treatment modality affords the greatest chance for eradication of disease while preserving the maximal amount of normal tissue.

High-Risk Lesions

The study of skin cancer and its behavior allows one to determine the lesions and locations with the greatest risk of recurrence. Numerous authors have attempted to delineate the characteristics or profile the features of a lesion that is at a significant risk of recurrence (Levine and Bailin, 1980; Koplin and Zarem, 1980; Rigel et al, 1981; Dubin and Kopf, 1983; Roenigk et al, 1986). In looking at recurrent BCCs, Levine and Bailin (1980) found the recurrence rate was greater for BCC when the histologic picture was of the morpheaform, adenoid, or metatypical variety. They found the most dangerous areas of the face were the nose, medial canthi, philtrum, and nasolabial sulcus, as well as the auricular and periauricular areas. In another series of patients from the same institution (Cleveland Clinic), Roenigk and colleagues (1986) concluded that Mohs' surgery should be used as the initial treatment

modality when (1) the BCC had high-risk histologic features (morpheaform, metatypical, or mixed type) or (2) the BCC arose in a high-risk location (ears, periorbital region, and nose).

Swanson (1983b) has determined the high-risk anatomic sites to fall within an H-zone of the face. In highlighting the specific regions at risk he cites (1) the junction of the ala with the nasolabial fold, (2) the nasal septum, (3) the nasal ala, (4) the periorbital region - specifically the inner canthi and lower eyelids, (5) the periauricular region extending to the temple, and (6) certain scalp lesions.

There are various features that must be considered when determining the risk of recurrence for a given lesion. They include the histologic features of the tumor, local extent and infiltration, tumor size, anatomic location, associated risk factors (such as patient age, prior radiation, and genetic syndromes), and previous treatment. The authors consider the risk factors shown in Table 1 to be indications for histologic documentation of tumor-free margins.

Table 1. Risk Factors

Histologic Features
Squamous cell carcinoma
Bowen's disease (CIS)
Basal cell carcinoma - morpheaform type
Keratotic basal cell carcinoma (basosquamous, metatypical)
Location
Nose, nasolabial sulcus, floor of nose, columella
Auricular, postauricular, preauricular
Periorbital region
Size
Lesions > 2 cm
Predisposing Factors
Any genetic predisposition or syndrome
History of arsenic use
Tumors arising in burns and scars
Tumors arising in the setting of radiodermatitis
Other Factors
Recurrent tumors
Tumors with significant tissue invasion.

Biopsy Techniques

The surgeon has multiple options available when managing a cutaneous lesions. The "innocent" lesions may be observed or treated with a topical medication, and close follow-up can be recommended. If the lesion is suspicious for malignancy, other choices have to be made, based on judgment and experience. Should the lesion be excised or is another treatment modality more appropriate? If excision is recommended, is a preliminary incisional biopsy necessary for proper treatment planning? Is frozen section control or Mohs' surgery indicated?

If these variables lead the surgeon to recommend an incisional biopsy, there are many methods available. Often the dermatologist uses curettage in combination with electrosurgery. The initial piece of tissue from the curette will serve as a representative biopsy of the tumor nodule. Shave or scissor excisions are another useful method in certain circumstances. Incisional biopsies can also be obtained using a dermatologic punch. These circular surgical knives come in various diameters and are capable of obtaining a clean plug of tissue. Many surgeons are comfortable with a standard wedge or fusiform incisional biopsy. In this technique, the biopsy will encompass not only a portion of the tumor but also a margin of adjacent skin. This technique yields two advantages. It allows the pathologist to examine the transition from neoplasm to normal skin. It also allows for suturing the defect because the neighboring skin is capable of coapting with sutures, whereas the tumorous tissue may not hold the stitch. The authors generally use a fusiform incisional biopsy or a punch biopsy for most incisional biopsies, although the other techniques are useful in selected lesions.

Treatment

Since most basal cell carcinomas behave in a rather innocuous manner, several treatment modalities have been used successfully in treating them. Table 2 illustrates the high success rate for these diverse modalities. Some of the modes of treatment currently in use include curettage with electrodesiccation, cryosurgery, radiation therapy, excisional surgery, and Mohs' surgery. The lesion and its histologic features, size, location, and extent of invasion will influence the choice of the preferred therapeutic approach. The experience, professional background, and bias of the treating physician will likewise have a significant influence on the modality used.

Table 2. Comparative Success in Treatment Methods Used for Basal Cell Carcinoma

Treatment Method	Success Rate (%)
Electrosurgery	92.6-98.0
Excisional surgery	93.2-95.5
Cryosurgery	94.0-97.0
Radiation therapy	92.1-96.0
Mohs' surgery	97.4-99.1.

Curettage With Electrodesiccation

The most common form of treatment used for BCC is curettage excision combined with the electrodesiccation. This treatment is also known as electrosurgery or ED and C (electrodesiccation with curettage). It is used primarily by dermatologists, who manage the vast majority of these lesions, and is highly successful when used appropriately, yielding cure rates of 92 to 98 per cent (Crissey, 1971; Kopf et al, 1977; Swanson, 1983a).

The rationale for this modality is that basal cell and squamous cell tumors have a soft "feel" that can be detected as a lesion is curetted. In experienced hands, this allows the excision of all palpable tumor with differing sizes of curettes. Once normal-feeling tissue is encountered over the entire base of the excision, electrodesiccation or fulguration of the wound is performed. The wound is treated topically and is allowed to heal by secondary intention.

The advantages of electrosurgery include maximal sparing of normal tissue, its ease of performance, and the rapidity of completion of therapy. The disadvantages include care of an open wound, depressed or hypertrophic scarring, and occasionally delayed bleeding. Electrosurgery should be used only in selected lesions, most commonly basal cell lesions less than 2 cm. Contraindications for this treatment modality include lesions with deep invasion, invasion of subcutaneous fat, morpheaform and sclerotic BCCs, and recurrent tumors (Swanson, 1983a). If squamous cell tumors are treated by this modality, they should be carefully selected.

Cryosurgery

Cryosurgery is another treatment option that may be appropriate for some basal cell lesions. As with electrosurgery, the skill and experience of the treating physician are critical. The most common cryogen used is liquid nitrogen. A temperature of at least -30°C is considered to be lethal to cutaneous malignant tissue, although some authors consider -50°C to be more appropriate. The tumor and an area of surrounding tissue are frozen to assure the adequacy of the ablation. A thermocouple inserted at the margin of the treatment area ensures that the proper temperature for killing the cells has been reached. The tissue is allowed to thaw, and after an appropriate period the freeze-thaw cycle is repeated.

Proponents of the technique cite as advantages its high cure rate, tissue-sparing capabilities, and expedience (Zacarian, 1987). It is also felt to be useful in tumors overlying cartilage, since cartilage can be frozen without undergoing necrosis. It may be particularly useful in patients with multiple lesions. The disadvantages include a prolonged healing phase and wound care. Hypopigmentation and unsatisfactory scarring can occur. Its use should be limited to lesions with well-defined borders and should not be used for morpheaform tumors or recurrent skin cancers.

Radiation Therapy

Radiation therapy has the capability of treating most skin cancers successfully and has been used widely in the past (Freeman et al, 1964; Swanson, 1983a). As more expedient and less radical methods of treatment have become popular, its use in recent years has waned. The

advantages of radiation include the ability to treat a wide field of tumor as well as avoidance of surgical intervention. The disadvantages include the protracted course of treatments, adjacent tissue effects, limited effect when tumors involve cartilage or bone, and the possibility of radiodermatitis and delayed carcinogenesis. Although many of these problems have been overcome with the refinements and advances in radiation technology, this modality is clearly overtreatment for most skin cancers. For these reasons, radiation is generally used in the treatment of poor operative candidates as an adjuvant to surgery, or for palliation in advanced lesions. It can be used as a curative modality, but careful selection of lesions and patients is crucial for its appropriate use.

Excisional Surgery

Surgical excision for cutaneous neoplasms is the modality with which most head and neck surgeons have the most experience. The success rate for this method of treatment is in the 93 to 95 per cent range (Ferrara, 1960; Freeman et al, 1964; Swanson et al, 1983). The major advantages of excisional surgery include the ability to obtain tissue for diagnosis as well as to assess the completeness of excision. By use of frozen sections, the surgeon can "chase" tumor as the margins of excision are evaluated histologically. Another advantage is the excellent cosmesis that can usually be obtained, particularly when defects are amenable to primary closure. The disadvantages are that excisional surgery may be more time-consuming, more inconvenient, and more expensive for the patient. Most surgeons feel that the histologic confirmation of the adequacy of excision outweighs these relatively minor disadvantages. The CO_2 laser can also be used for excision of cutaneous carcinomas and will be discussed in more detail in the section on surgical technique.

Mohs' Surgery

Frederick Mohs pioneered a new technique for removal of cutaneous neoplasms while he was a medical student in the 1930s. His first results were published in 1941, and the new modality was dubbed *chemosurgery technique* (Mohs, 1941). With this method, zinc chloride paste (a chemical fixative) was applied to the cancer, which was then fixed in situ, permitting careful serial excisions with examination of the entire specimen histologically. This allowed him to map out the pockets of residual tumor so that re-excision of that area could be undertaken. The cure rates associated with the technique range from 96 to 99 per cent (Mohs, 1941; Robins, 1981; Mohs, 1987). Tromovitch and Stegman (1974) revised the original technique and used a fresh tissue technique that adhered to the same tenets of serial excisions and mapping of residual tumor deposits. The nomenclature for the technique has now evolved to the point that *Mohs' chemosurgery* implies a fixed tissue technique, whereas *Mohs' micrographic surgery* implies use of the fresh tissue technique. The vast majority of dermatologic surgeons now use the fresh tissue technique, and the common terminology used at present is simply Mohs' surgery. Details of the technique are published in numerous sources (Tromovitch and Stegman, 1974; Swanson, 1983b; Swanson et al, 1983). A schema of this process is shown.

The advantages of Mohs' surgery lie in the surgeon's ability to examine the resection margins in their entirety as opposed to routine or frozen section margins, which evaluate only a random sampling of margins of excision. In this fashion, microscopic foci of tumor can be identified, mapped, and re-excised. This technique also allows for removal of the neoplasm

with maximal preservation of surrounding normal tissue. Other assets of the Mohs' fresh tissue technique include the ability to immediately reconstruct the defects that have been created. Certainly the major advantage is that this technique has the highest cure rate in the management of advanced, high-risk, or recurrent lesions. Swanson (1983b) has proposed the indications for Mohs' surgery as those shown. The disadvantages of the Mohs' technique are the special expertise, time, and expense involved. Someone with this special training may not be available in all communities. Once again, these drawbacks can be well compensated for if a disease-free status can be obtained.

The Authors' Technique of Surgical Treatment

Biopsy

Biopsy is employed as a preliminary step in those situations in which the clinical diagnosis is in doubt or in which subsequent resection of the lesion will result in a marked degree of disfigurement or loss of a vital structure. Likewise, if irradiation is to be employed or is considered as the primary mode of therapy, histologic confirmation of malignancy is necessary.

Surgical Excision

In the past, when skin cancers were excised primarily without a prior biopsy, most authors recommended margins that were much greater than those used today. With the use of Mohs' fresh tissue technique and excision with frozen section control, resections can be more conservative. Recurrent tumors in which margins are ill-defined present a more difficult problem because excision depends on the clinical appearance of tumor extension. The employment of microscopic control allows detection of microscopic extensions that are not apparent grossly.

The Mohs' method is time-consuming and inefficient for most skin cancers of the face. It is, however, extremely effective in aggressive lesions and for lesions involving the "danger zones" of the face, such as the medial canthus, nasal spine, ear canal, and eyelid. This method is particularly helpful in treating recurrent cancers and morphea-type BCC. Our routine is a modification of the Mohs' fresh tissue technique, in which frozen section specimens are oriented in a fashion similar to the sections in the Mohs' technique.

Carbon Dioxide Laser

Laser excision is appropriate in the management of some skin malignancies. There are three situations in which laser excision may be preferential to standard excision. The first indication is in those patients whose cardiac status or other medical conditions render it unwise to employ epinephrine in the local anesthesia. Lidocaine without the addition of a vasoconstrictor has a duration of approximately 15 minutes, which is more than adequate time for the few minutes required to resect most facial lesions in a bloodless fashion with the CO_2 laser. If margins are involved with disease, more anesthetic is infiltrated in the area required and further tissue is removed as needed. When margins are determined to be free of tumor, the area of the local flap is infiltrated, and the reconstruction is carried out. The authors have also found laser excision to be of benefit in patients with bleeding disorders.

Another indication for use of the CO_2 laser is the resection or vaporization of small multiple lesions that require no reconstruction. Lesions as large as 7 to 8 mm can be resected bloodlessly and are left with a physiologic dressing that heals completely within 10 days, resulting in excellent cosmesis. This method is particularly effective in managing multiple premalignant or potentially malignant lesions often found in those patients with skin cancer.

Palliation of the neglected lesion, in the very elderly or debilitated patient whose skin cancer is of less concern than more major health considerations, is carried out with alacrity using the CO_2 laser. These patients often reside in limited-care facilities, and palliation can be directed toward improved nursing care, better patient comfort, and convenience. These goals prompt some type of treatment, although cure may not be propitious or possible.

Surgical Reconstruction

There are three fundamental methods of managing the defects created by excisional surgery for skin cancer: (1) no reconstruction, (2) immediate repair, or (3) delayed reconstruction. The first alternative is used in the situation in which the wound is allowed to heal secondarily or is covered by a graft and the subsequent defect left as is. This may be appropriate for patients who are undergoing palliation or for other reasons are not candidates for reconstruction. Some patients may be better served with a prosthesis.

Many factors influence the choices open to the surgeon, such as the general health of the patient and his or her life expectancy. The location and extent of the lesion, as well as the social situation of the patient, may play a role in the decisions concerning reconstruction. Large defects are of little concern to some people, whereas small ones can be catastrophic to others.

Functional restoration takes precedence over cosmesis if this choice must be made. This would include, for example, reconstructing the upper lip to ensure a competent oral sphincter before commencing nasal reconstruction. Early reconstruction of nasal alar and eyelid defects is of paramount concern, since reconstruction after contracture has occurred is rarely satisfactory.

Aside from functional restoration, anatomic, pathologic, and cosmetic considerations will influence the surgeon's decision-making process in choosing appropriate reconstructive options. Basic to any flap reconstruction is the secondary tissue deficit, which when closed results in increased tension upon the surrounding local tissue. As scar contraction occurs, it has the potential to distort and create a greater deformity. The use of a skin graft decreases this likelihood by harvesting tissue in places in which there is an abundance, usually some distance from the defect, and substituting this tissue for that of the resected tumor.

Anatomic considerations control surgical options by imposing constraints such as symmetry, facial landmarks and structures, and the lack of availability of adequate local or adjacent tissue. One must always keep in mind that all flaps create a secondary defect, which subsequently must be closed in some manner. This is most often done by primary closure, but one can use another flap or a graft.

Pathologic considerations influence reconstructive choices, and the defects related to certain histologic types might best be covered with a skin graft rather than have potential tumor hidden by a thick flap. Questionable margins are another factor that might prompt a more conservative choice. It might best not to use a thick flap to initially reconstruct tumors located in areas known clinically to be more virulent - that is, the medial canthus, nasal spine, and external ear canal. SCCs of the skin are usually more aggressive and infiltrative than are BCCs, and this should be kept in mind in their management. An exception to this is the morpheaform BCC, which is noted for its infiltrative nature. Its "iceberg-like" subdermal extension may make elaborate reconstructive efforts futile and perhaps devastating to the patient. It is wise to forego immediate reconstruction and allow healing by secondary intention or cover the defect with a skin graft. Reconstruction can be undertaken when one is reasonably sure the patient is tumor-free, usually after a period of observation of 1 to 2 years.

Planning Reconstruction

In designing the reconstruction, one must first consider the effects on adjacent tissues and structures. It is essential that the tissue to be moved into the defect be lax and abundant enough to close the surgical void. The donor area must be closable, usually primarily, without unacceptable consequences to adjacent tissues or structures. Utmost in the surgeon's mind must be the placement of incisions. Closure lines should be in the most cosmetically acceptable locations, such as in skin creases, facial structural demarcations, and relaxed skin tension lines. The tension and direction of maximum pull must not distort, create asymmetry, or result in an unacceptable scar. The ultimate contracture of the resulting scars must not be such that a late deformity could result.

A review of our surgical cases indicates that the most common management following resection is advancement and primary closure. Obviously this technique is propitious for the majority of small lesions. For those requiring a more sophisticated form of reconstruction, there are clearly a number of reliable reconstructive options.

To obtain approximate percentages, we looked at the methods of reconstruction used following resection of 100 consecutive nasal lesions. Although many of the larger lesions, especially those requiring inner as well as outer resurfacing, were reconstructed with more than one flap, we were able to easily identify the primary mode of reconstruction (Table 3).

Table 3. Methods of Reconstruction of Nasal Defects

	%
Midline forehead flap	26
Sliding nasal dorsal flap	24
Perichondral cutaneous graft	18
Nasolabial flap	15
Other methods	17.

The Midline Forehead Flap. This is the most reliable local flap used in facial reconstruction. It requires no delay, can be primarily lined, and is equally reliable if one of the supratrochlear arteries is sacrificed with the resection (Stucker et al, 1983). The disadvantages of this flap are that it always requires a second stage, and it may not reach the nasal tip in patients in whom the forehead has a short vertical dimension. Traditionally this

flap is twisted or rotated to use the forehead skin as external lining. This flap is readily grafted primarily when an inner and outer lining are required (Shockley et al, 1984). We have modified this flap by not twisting it and by using the forehead skin for internal nasal lining and temporarily skin grafting the raw outer surface. At a second stage, the skin graft is removed and the flap is divided at its base and "somersaulted," thus achieving nasal tip bulk. This two-staged procedure relies on forehead skin for both inner and outer lining of the reconstructed nose. The reliability of this flap is attested to by our finding of no loss of tissue in more than 90 cases in which a midline forehead flap was used.

The Sliding Nasal Dorsal Flap. This is an excellent reconstructive option for many nasal lesions. It represents a single-stage closure and is generally associated with a superb cosmetic result. It takes advantage of the excess skin in the glabellar region and because it is hinged on one side slides this region of tissue into the area of deficiency. This flap has no potential for internal lining and must not be used for extensive lesions. It is not as reliable as the midline forehead flap, but careful planning and execution usually lead to a successful outcome. It is important to elevate only skin on the side to be advanced caudally. As elevation proceeds across the midline of the nasal dorsum, the flap on the hinged side includes all the tissue down to the perichondrium and periosteum. This maneuver ensures proper thickness of the pedicle and maximizes the blood supply to the base while keeping the dissection from violating the angular vessels on either side.

A Perichondral Cutaneous Graft. This is harvested from the conchal bowl region and is another single-stage method of reconstruction. It is a very reliable graft that yields excellent cosmetic closure of facial defects. In our hands, it is more reliable than either full- or split-thickness skin grafts and yields far superior cosmetic results. It has an excellent color match, does not contract, and effaces depressed areas better than a full-thickness skin graft. The donor site (conchal bowl) is closed primarily with a postauricular island "flip-flop" flap (Stucker et al, 1983). The perichondrial cutaneous flap is placed over and sutured into the resection site in a manner similar to that for a full-thickness skin graft. In most cases, no bolster is used. Instead, 5-0 or 6-0 chromic sutures are strategically placed through the graft and underlying tissue to ensure proper graft coaptation. Bolsters of cotton dental rolls are used at the donor site. One is placed in the postauricular sulcus and the other is formed to fit into the conchal bowl. The tissues are coapted between the rolls with 3-0 nylon mattress sutures, which are left in place for 3 days.

The Nasolabial Flap. This is a dependable and versatile flap, but it is somewhat overused for nasal reconstruction. Its reliability is excellent, and the redundant skin of the cheek is easily mobilized and advanced to place the donor closure line at the lateral margin of the nose. The unfortunate aspect is that the rotation of either the superiorly based or inferiorly based nasolabial flap often makes it obvious that a reconstructive effort is under way. We recommend a minor second stage of the inferiorly based nasolabial flap to camouflage the deformity (Stucker et al, 1983).

The delayed inset of the nasolabial flap circumvents the surgical look of this reliable and versatile flap when reconstructing defects of the columella, septum, and floor of the nose. Rotating the inferiorly based nasolabial flap into these areas usually requires an alotomy, and primary closure often results in an unacceptable distortion. The asymmetry of the ala can be avoided by suturing the flap into the defect and performing closure of the advanced cheek

skin into the donor site. The alar base is not sutured, and the raw undersurface is allowed to heal by epithelial migration. After 2 to 3 weeks, the second stage is scheduled, after the swelling has subsided and the tip of the flap is no longer dependent upon its base for its blood supply. The placement of the ala is a mirror of its opposite mate to ensure symmetry. The epithelial undersurface of the ala is resected, as is a small piece of skin from the nasolabial flap beneath the precisely placed ala. The ala is then sutured into the bed without fear of jeopardizing the blood supply to the flap.

Another common use of the nasolabial flap is an island variant that is used as a turn-in for reconstruction needing endonasal lining. The donor defect is closed, with the incision lying in the nasolabial crease. The nasolabial flap can also be used in combination with a sliding nasal flap for full-thickness alar base reconstruction. As can be seen, variants and various combinations of commonly used flaps are readily adaptable to reconstruction.