Chapter 5
Disfigurement

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Disfigurement of the Head and Neck and Quality of Life

Due to the highly visible nature of the region of the body in which head and neck cancers exist, special considerations must be made regarding the significance of disfigurement that results from treatment of this area. Body image is defined as a "dynamic perception of one's own bodily appearance, function and sensations, as well as feelings associated with this perception" [1]. Such feelings may arise in response to reactions from others, an additional component of the definition of body image found in Webster's Dictionary [2]. Reactions from others that are negative in nature may trigger psychological distress, in which case body image *disturbance* is present [3].

While the scope of this chapter encompasses disfigurement of the entirety of the head and neck, it is easy to surmise the disproportionate importance of facial disfigurement in this patient population. The face is the recipient of high visual traffic as it is the aesthetic and identity center of the body. Its importance cannot be understated as patient fear of anticipated changes in facial appearance after treatment of head and neck cancer may sometimes outweigh fears of recurrence of the disease itself [4].

A significant contributor to anxiety in the setting of disfigurement is a patient's collection of experiences of public reactions to their physical appearance. The disgust response to abnormal stimuli is a learned behavior acquired early in life (ages 4–8 years) [5, 6], evidenced by frequent appearance-based childhood teasing and bullying [7]. This, combined with unwelcome behaviors (stares, startle reactions, whispering, questions, avoidance) from observers later in life [8], can invoke feelings of rejection or social pain, perceived by the brain similar to physical pain [9].

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Objective Assessment of Head and Neck Disfigurement

The first observer-based assessment of head and neck disfigurement was proposed by Dropkin in 1983, in which nurses assigned grades of disfigurement severity to photos of artificial deformities from various head and neck cancer surgeries (in order of severity from least to most disfiguring: radical neck dissection, cheek resection with forehead flap, total parotidectomy with facial nerve sacrifice, total laryngectomy, bilateral radical neck dissection, orbital exenteration, hemimandibulectomy with radical neck dissection, nasal amputation, anterior partial mandibulectomy, segmental mandibulectomy with radical neck dissection, orbital exenteration and radical maxillectomy). This study concluded that resections involving the mandible and central face are the most severely disfiguring, serving as a guide for patient counseling prior to reconstructive surgery [10]. This study's shortcomings were noted by Katz et al., who noted that the preceding grading system overgeneralized disfigurement outcomes without consideration of reconstructive techniques, presence of surgical complications, and history of radiation. It was not until 2000 when another system was proposed, this time modeled on four dimensions: (1) size of the disfigured area, (2) degree of face/neck shape distortion, (3) extent of impairment of facial expression, and (4) visibility of the disfigured area. Grading was based on a 9-point Likert scale with scores of 1, 5, and 9 elaborated further: (1) disfigured area/scar small in size, shape of face/neck not distorted, facial expression not affected, disfigurement minimally visible (close range only); (5) disfigured area/scar moderate in size, shape of face/neck somewhat distorted, facial expression somewhat affected, disfigurement moderately visible; and (9) disfigured area/scar large in size, shape of face/neck very distorted, facial expression very affected, disfigurement very visible (from afar). Inter-rater reliability was high (intraclass correlation coefficient 0.91), indicating agreement among the group of raters (consisted of surgeons, a psychiatrist, and research assistant) [11].

Coping with Disfigurement

Within the facially disfigured population, both women and young patients are disproportionately negatively affected by their disfigurement. In most cultures, women place a higher value on facial attractiveness than their male counterparts [12]. Overall, results are mixed when comparing appearance-related depression and anxiety between men and women. Some studies suggest that women experience these comorbidities more frequently than men [11, 13–15], while others have reported that gender-based differences do not exist [16–19]. In terms of age, individuals affected by disfiguring processes in the head and neck in adolescence and early adulthood experience marked difficulties with adjustment [20, 21].

It can be difficult to predict how individuals will cope with head and neck disfigurement. While it is clear that some patients habituate to change better than others,

type and severity of disfigurement in this region of the body have failed to predict acclimation success [22]. A better predictor of psychological distress in these individuals is their perception of how apparent their disfiguring features are to the general public [23]. Some have argued that congenital facial malformations are easier to "adjust" to, given that affected persons have no memories of life without them [24] and that an increased amount of time facilitates adaptation to reactions from the public [25]. People with acquired disfigurement, on the other hand, must learn adjustment measures after accepting changes in their appearance [26]. In general, patients with limited flexibility experience more emotional difficulties related to their appearance, as demonstrated by Shepherd et al. in a burn patient population [27].

Specific interventions to aid in coping strategy development exist. In cases where cosmetic surgery is available, stress related to a specific feature may decrease, but overall body image likely will not [28]. Changing Faces is a charitable organization in the United Kingdom that provides services to individuals "with a visible difference: a mark, scar or condition that makes them look different" [29]. Social skills training for disfigured individuals offered by this organization was shown to increase confidence levels in new environments [30]. This is of particular benefit given that transitional periods in life (new school, job, etc.) are distressing [23] to persons with disfigurement. Perhaps more effective are the presence of patient social support [11, 31] and frank provider discussions on expected outcomes prior to treatment. In a 1979 article discussing emotional management of head and neck cancer, Herzon and Boshier noted "it may be cruel to lead the patient to believe that his or her appearance, even after reconstructive surgery, may not be changed significantly as a result of a major operation. A team member who attempts to 'spare the family' by withholding certain information is usually motivated by a desire to spare himself/herself the pain of relating difficult facts, and such attempts are not a kindness to the family" [4].

Reconstructive Considerations

The greatest determinant of postoperative disfigurement is the patient's cancer itself, as it will determine the extent of normal tissues that are resected. While the same surgeon may be performing the oncologic and reconstructive portions of a head and neck cancer operation, ideally the reconstruction should not be considered at all while resecting the cancer. This separation of surgical goals ensures that no oncologic corners are cut to ease the reconstructive burden. That being said, there are some factors that the oncologic surgeon can focus on that may lessen future disfigurement and limit the postoperative patient burden. Most of these factors involve surgical techniques that may limit lymphedema or the musculoskeletal impairment postoperatively and will be discussed below. The greatest dilemma for the reconstructive surgeon is the balance of form and function in planning head and neck reconstruction, for the head and face house structures just as functionally important to life as the region is visually important to body image. This balance may slant one

way or the other variably (even dramatically so) in different patients with similar surgical defects based on the patients' goals. Unfortunately, as already discussed the ability to accurately predict a given patient's response to physical disfigurement is difficult at best, and aligning with their preoperative goals does not ensure that the patient will be satisfied.

Nevertheless, preoperative counseling becomes crucial to the reconstructive surgeon. First and foremost, the surgeon and patient need to discuss the reality of what tissues will be absent after resection so the patient understands what challenges they will face. With that common understanding, the surgeon and patient can act as a team to prioritize function such as breathing, voice, swallowing, and physical activity/mobility as well as form, in the alteration of their physical appearance. It goes without saying that the ultimate goal is to maximize both physical function and physical appearance; however reconstruction of many defects may require sacrifice of one for the other, and the patient should ideally have the final say in where that effort lies. The impact of nutrition and speech and swallowing impairment will be discussed elsewhere in this book and won't be reiterated here.

Volumes have been written on reconstruction in the context of head and neck cancer, and the surgical considerations in limiting disfigurement cannot be comprehensively addressed in this chapter. Instead, the primary thought processes of the head and neck reconstructive surgeon will be highlighted in the sections below without specific technical details.

Site-Specific Disfigurement

Facial Nerve Palsy

Paralysis of the facial nerve can result from many causes beyond that of oncologic resection and has thus been studied for decades. The body of literature available on psychosocial consequences of facial paralysis and palsy (described henceforth as FP) is extensive. The face is the primary instrument of nonverbal communication, and any deficit in its function taxes an individual's ability to convey emotions effectively. What is more, in efforts to compensate for lost function, FP patients may be prone to communicate in unconventional ways, sometimes resulting in miscommunication [22]. The reverse scenario carries similar consequences, with observers indicating difficulty with "reading" expressions on FP faces, yielding hesitancy in and shorter exchanges between observers and FP patients [8]. In multiple studies, general observers have perceived paralyzed faces to be negative (even when in repose) and less happy, attractive, trustworthy, and intelligent than normal subjects [32–35].

Concomitant with the stress of physical disfigurement secondary to facial palsy, FP patients may also have other psychological preoccupations related to social faux pas such as oral incompetence leading to drooling or leakage of ingested foods or drinks.

VanSwearingen et al. were among the first to demonstrate that psychological distress stemming from facial palsy significantly predicted social disability in affected patients [36]. Using a variety of quality of life instruments, many subsequent studies have reported the presence of anxiety and depression in patients with FP [33, 35, 37–44] [references for all, including studies w/o control groups] at increased rates relative to subjects with normal facial function. Notably, facial palsy severity does not predict severity of psychological distress.

When disfigurement in the setting of facial palsy exists without a concomitant soft tissue defect (i.e., facial nerve sacrifice in a parotidectomy with primary closure), treatment targeting the impairment is more likely to be successful at correcting the disfigurement. The literature indicates that patients treated for FP, either conservatively with botulinum toxin or more definitively with static or dynamic reanimation surgeries, experience significant improvements in quality of life [45–48]. Comprehensively addressing the surgical management of facial paralysis is beyond of this narrative, but as a general rule, any procedure (whether static or dynamic) is better than flaccid paralysis of the face. Whenever possible primary nerve grafting is preferred, with cross facial nerve grafts or nonanatomic grafts such as the masseteric nerve being of large benefit as well, alone or in conjunction with static procedures. Innervated gracilis free flap is best performed by an experienced team but can have excellent results, particularly when there is no remaining useable facial nerve or facial musculature.

Laryngectomy

Total laryngectomy represents a distinct entity within the realm of surgical head and neck disfigurement. Resultant physical changes from laryngectomy can easily be concealed from the public yet can simultaneously trigger significant psychosocial comorbidities in the affected patient. In general, laypersons tend to be fearful of airway stomas, whether they exist as tracheostomies or formalized laryngectomy stomas due to a lack of understanding of the disease processes that lead to their necessity as well as the communicative limitations they carry. This leads to social isolation of laryngectomees, as patients (women in particular) gravitate toward withdrawal due to a perceived lack of acceptance of their new condition [24]. New laryngectomees frequently develop psychosocial anxiety and depression similar to other patients with head and neck disfigurement. Over time, however, a subset of laryngectomy patients become resolute and/or transformed from their postoperative disfigurement (5 of 11 in a group described by Bickford et al.) [49]. Others, however, will continue to struggle with social stigmata of their stomas.

Studies have demonstrated that women suffer greater adjustment problems after laryngectomy [49, 50] despite men comprising a majority of patients with laryngeal cancer [51]. In some cases, this is attributable to postoperative stress-provoking reactions from strangers – “it is mainly the way people look at you, the

way they talk to you" [49]. Another female laryngectomee published an editorial on her experiences, in which expressed:

> The first look in the mirror is devastating. The stoma is located at the base of the neck. It is open and obvious. If there has been additional neck surgery, that side of the neck is sunken and forever after will have a "scrawny" appearance. The immediate problem is to cover the disfigurement and at the same time allow air to get into the lungs….A woman, because most dresses are open at the neckline, must devise attractive measures to cover the stoma. Until this problem is solved, she may find herself a virtual prisoner in her home. Once covered the stoma is not forgotten. It is especially difficult for a woman to learn to accept this permanent disfigurement. The neck is a sensitive, sensuous area of the body [52].

Beyond that of anecdotes, in a retrospective cohort of laryngectomees, women reported significantly lower scores for global health status, quality of life, and functioning in multiple domains (physical, emotional, and social) compared to men [19].

In line with head and neck cancer patients in general, adjustment to life after laryngectomy is improved in the setting of adequate social support structure after surgery [53]. Time also furthers the emotional healing process of laryngectomees [54], with surgery-related stress levels tapering by 1 year postoperatively [19, 55]. While disfiguring sequelae from total laryngectomy is not discounted, it is encouraging to be able to counsel patients on the optimistic expected trajectory of their recovery and adjustment.

As the presence of an end tracheostoma is unavoidable in a laryngectomee, the impact of the reconstructive surgeon on this disfigurement is limited. However, in cases where the pharynx must be reconstructed or when non-radiated soft tissue is desirable, the choice of reconstructive tissues can have a long-term impact. The pectoralis major, as a myocutaneous flap or a myofascial interposition graft, retains an attachment to the origin of its vascular pedicle below the clavicle. This adds an additional deformity in the form of a visible asymmetry between the donor and normal sides of the neck and clavicle areas which can be avoided with free tissue transfer or use of other regional tissue such as the supraclavicular flap that has no muscular component to the pedicle. When the pectoralis muscle is excessively bulky, the superiormost portion of the muscle (proximal to the insertion of the vascular pedicle) may be thinned or even completely resected to limit the evidence of the muscle passing over the clavicle. The more distal portions of the muscle cannot be thinned (in a myocutaneous flap), and thus the large bulk can lead to further deformity of the neck, particularly if the native skin cannot close over this bulk and skin grafting is necessary. As long as the motor innervation of the muscle is transected, some of the muscle volume typically decreases with time or at least softens as fatty replacement of the muscle occurs.

The presence of an open fistula can also have devastating impact on a patient due to the addition of another visible opening as well as potential odor and discharge. While most fistulas are resolved spontaneously or surgically relatively early in the postoperative period, this becomes the patient's earliest conception of the change in their body creating a much more dramatic first impression that is difficult to overcome. In radiated patients, the use of non-radiated tissue for pharyngeal reconstruction or muscle interposition with primary pharyngeal closure may help

limit the risk of fistula [56–65]. The body habitus of the patient guides the surgeon to the most suited reconstructive tissues. For example, in a very thin patient, a free latissimus flap is very desirable for post-laryngectomy reconstruction for can be harvested with a cuff of muscle extending past the skin paddle in all directions which will overlay all of the mucosal closure (much like a pectoralis flap, but without the drawbacks above). However, in the obese patient, this flap becomes nearly prohibitive by its bulk, and all other myocutaneous flaps may have the same prohibition, leading the surgeon to use a thinner fasciocutaneous flap such as the radial forearm free flap.

Oral Cavity Disfigurement

The vast majority of head and neck cancer cases are due to mucosal squamous cell carcinoma. A large portion of these cases are due to a lesion of the oral cavity (i.e., lip, tongue, floor of the mouth, buccal and mandibular gingiva). Surgery can leave a large volumetric and surface area defect requiring some type of reconstruction; however, the impact of disfigurement from intraoral defects is not reported well in the literature. Intuitively, the oral cavity is where advances in free flap reconstructive surgery can be most pronounced. With microvascular free tissue transfer, the reconstructive surgeon is able to significantly decrease the potential loss of form and function caused by the tumor. Over the recent decades, expected free flap survival has become >90% and as such has become the standard of care reconstruction for the oral cavity in these advanced cases.

External changes in appearance are common after oral cavity resection and reconstruction. The extent of this change and the potential for disfigurement are related to the primary site of the lesion, reconstructive method, and success and need for adjuvant treatment. The size of the lesion and the pathologic features requiring the need for adjuvant therapy are typically out of the surgeon's hand (except in the case of close or positive margins); however the reconstructive options are diverse and can produce effective long-term quality of life for these patients [66]. Although there are viable primary, secondary, and locoregional options for reconstruction, this specific discussion will cover the role of free flap surgery, which is most commonly used for advanced lesions. Certainly, it is prudent to utilize primary closure, secondary healing, or the use of skin grafts and other local grafts when able to do so without functional consequence however. The goal of reconstruction is to restore form and function. This can be achieved with various levels of success depending on one's ablative defect.

In oral cavity disease, there is more potential for external disfigurement when the mandible is involved. Reconstruction of the mandible almost always requires free flap reconstruction, most commonly utilizing the fibula, scapula, or osteocutaneous radial forearm free flaps. Considerations to improve the cosmetic and functional outcomes include bony height of the flap, bone stock for potential dental implantation, and anterior/posterior and vertical placement of the reconstructed anterior arch.

Patient factors are critical to consider when selecting the donor site for reconstruction, as are factors such as vascular anatomy, history of atherosclerosis, and adjacent mucosal defect and soft tissue required for reconstruction. Careful reconstructive selection; the expanded use of low-profile, titanium mandibular reconstructive plates; and preoperative virtual surgical planning have greatly improved our ability to precisely and durably reconstruct the mandible.

Skin and mucosal cancers of the lip can produce dramatic visual deformity and require special attention by the reconstructive surgeon. Reconstruction of the lip may include primary closure with and without M-plasty for larger lesions, local tissue rearrangement with Abbe and Estlander flaps, more complex locoregional rotations including Bernard-Fries and Karapandzic flaps, as well as free flap reconstruction for total lip defects. All of these reconstructions leave patients with scars and some degree of microstomia. The goal of reconstruction is to limit the sphincter dysfunction and preserve as much size as possible for mouth opening. These patients' functional quality of life after lip surgery depends largely on the size of the primary tumor and the technique used for reconstruction. When able, primary closure, stairstep, and Abbe/Estlander reconstruction should be used over the more involved techniques [67].

Dental Reconstruction

One of the most significant implications of head and neck cancer treatment remains the impact on dental status. Poor dental hygiene is a well-known risk factor for head and neck cancer, and as such, many patients already have poor dentition requiring dental extraction or an already edentulous state. This obviously simplifies dental reconstruction as the use of prosthodontics for denture fabrication gives patients an excellent appearance and ability for improved mastication. For the patient who already has partial or full dentures, the impact is often minimal; however, a patient with intact dentition (however poor) who undergoes significant dental extractions will often have a dramatic change in their self-image. Those head and neck patients who have quality dentition at the time of diagnosis are likely to have their current state of dental health disturbed by surgery and/or radiation therapy. Preoperative dental evaluation remains critical to identify periodontal disease and address this at the time of surgery or at least prior to radiation therapy in order to reduce the risk of osteoradionecrosis of the mandible long-term, as this can lead to severe disfigurement with potential for significant mandibulectomy after the patient has already adjusted to their post-cancer (and post-cancer treatment) physical state.

Patients with cancers of the mandible or maxilla likely require resection of a portion or all of the teeth-bearing bone in that region. Reconstructive options include use of an obturator (maxilla) and locoregional or free flap reconstruction. Currently when significant portions of the mandible or maxilla require resection, free flap reconstruction has become standard of care [68, 69]. The options for free flap reconstructions are vast and dependent on the defect; however when bone is to

be reconstructed, the options include the fibula, radial forearm, scapula, and iliac crest osteocutaneous free flaps [70]. Typically for large mandible defects, the fibula and scapula are the flaps of choice; however with improved techniques in bone harvest and radial plating, the osteocutaneous radial forearm flap (OCRFF) has gained popularity in this setting as well [71]. If osseontegrated dental implantation is planned preoperatively, the fibula specifically but also the scapula and iliac crest bone stock offers a better conduit for the implants. Success of dental implantation in the fibula has been widely seen and reported for many years [72–74]. Other bony flaps, such as the scapula and OCRFF, may require modified surgical techniques and/or additional prep work such as bone grafting or augmenting prior to implantation. Techniques such as "double-barreling" can be used to increase the thickness of bony stock for later implantation [75].

For complex defects or when immediate, single-stage dental reconstruction is to be performed, three-dimensional CT planning guides have become commonly used with great success. Using the patient's preoperative imaging, custom plates and cutting guides can be utilized to reconstruct the mandible or maxilla and even perform dental implantation at the time of primary reconstruction. This technique has gained popularity due to the efficiency of single-stage surgery, accuracy of the custom planning guides and plates, and the ability to fabricate the neo-mandible during the ablative portion of the case while still vascularized in the lower extremity [76, 77].

Amputations: Orbital Exenteration, Rhinectomy, Auriculectomy, and Maxillectomy

Removal of sensory end organs such as the eye, nose, and ear and maxillectomy are among the more severely disfiguring head and neck cancer resections performed [10]. Expected psychosocial distress from resulting aesthetic and functional outcomes ensues and must be prepared to be addressed.

The body of literature regarding quality of life after eye amputation is sparse; however two studies found that individuals who underwent removal of the eye with or without exenteration suffered social detriments from the procedure. Forty percent of individuals in a study by Coday et al. reported these outcomes, while Rasmussen et al. showed that mean scores in the social functioning domain of the Short-Form 36 quality of life questionnaire were significantly lower for affected patients compared to a general population [78, 79]. Extended periods of time permit greater patient and family acceptance of disfiguring outcomes following many head and neck cancer surgeries; however it seems that the converse may be true after orbital exenteration. A qualitative study consisting of interviews of 12 affected patients reported that half of patients grew more concerned about their appearance as time progressed, as fears surrounding the disease process itself were replaced [80]. This indicates the longevity of aesthetic concerns from removal of an individual's eye. After orbital amputation, there is no surgical recreation of the globe with any real-

ism, and maintenance of the appearance of a globe will require a prosthesis. This is most easily accomplished when the surgical defect is limited to the orbital contents; however when it extends to the sinonasal cavities, the presence of air pressure and mucus can limit the fit of a prosthetic eye, and local or regional tissues should be utilized to isolate the orbit if possible. It is rare for malignancies in the orbit to allow preservation of enough structure to maintain functioning eyelids, but this skin is often useful for relining the orbital defect, and the prosthesis recreates the lids and globe. For isolated upper maxillary/orbital defects, the long pedicle of the osteocutaneous forearm, scapula tip, or serratus/rib free flaps are often of most use, and the bone stock of all are adequate as the bone is non-weight bearing. Alternatively, if there is adequate soft tissue for healing, a large prosthesis can replace a significant portion of the face. As a prosthesis grows in size, the utility of bone-anchored securement points increases, and the placement of these should be considered at the time of primary reconstruction (particularly if the patient is to receive radiation). The patient must be counseled ahead of time that even a perfectly constructed prosthesis is a static device, and the globe will not move and consequently only look symmetric with forward gaze.

Nasal reconstruction is a special entity within head and neck surgery. Unlike the ear and eye, realistic-appearing surgical reconstruction of the nose is well within the capabilities of a talented reconstructive surgeon, even with total rhinectomy. Nasal prostheses also have a very realistic end result with the downside of being removable. This fact alone may guide many patients toward surgical reconstruction of the nose as seeing themselves without one of the most defining features of their face (even if only for brief periods when a prosthesis is removed) may be devastating. The options for treatment of nasal defects are numerous, and each rung of the reconstructive ladder is realistically employable. Consistent with all other subsets of head and neck surgical patients, those who have undergone partial rhinectomy and reconstruction experience poorer nasal self-image compared to controls (23.27 vs. 30.61, Nasal Appearance and Function Evaluation Questionnaire, maximum score 35) [81]. Despite this, multiple studies have reported patient satisfaction with appearance >80% following partial nasal reconstruction [82–84]. Surprisingly, in a survey of 33 patients by Moolenburgh, aesthetic satisfaction after nasal reconstruction was not affected by size of rhinectomy defects (University of Washington Quality of Life Survey) [85]. Their overall satisfaction scores (rated 0–100) were very similar to those from 43 nasal prosthetic patients in a separate study by Becker et al. (84 vs. 83.14) [86]. In the Moolenburgh nasal reconstruction study, patients rated their postoperative appearance notably higher than a panel of five plastic surgeons, indicating high patient satisfaction with surgical reconstruction (4.2 vs. 3.5, $p = 0.031$). There are no large series reporting outcomes after total nasal reconstruction due to the relative infrequency that these procedures are undertaken. The largest series to date reported on nine total rhinectomy patients, seven of whom selected prosthetics over free flap reconstruction [87]. Four of the nine (treatment modality unknown) ultimately required initiation of antidepressants for new depression that began after surgery. The author of this series felt that nasal prostheses were the treatment modality of choice, however a few case reports that present successful para-

median forehead flap and free flap options for total nasal reconstruction [88–90]. Reconstruction of a total nasal defect is a significant task, requiring careful patient selection due to the length of time needed for surgery of this extent.

Auriculectomy, like rhinectomy, defects may be reconstructed using any option on the reconstructive ladder. Prosthetic use in this population is generally well-tolerated, perhaps because of the location of the ear off of the face. In general, auriculectomy patients tend to fare better with regard to psychosocial distress from their surgical defects compared to other head and neck patient groups (Fig. 5.1). In a survey of 23 auricular prosthetic users, only 1 patient reported embarrassment secondary to his/her prosthesis [91]. In another survey of 14 auricular prosthesis users, a mean social functioning score of 90.6 out of 100 was reported [92]. In cases of subtotal auriculectomy, preservation of the helical root when possible allows for decreased visual impact on frontal view as well as maintaining use of non-modified eyewear. While there is extensive literature on auricular reconstruction in cases of microtia, trauma, and other benign disorders, it is more controversial in adults and is rarely undertaken in cases of malignancy. Arora et al. noted that due to a frequent lack of useful surrounding skin and soft tissue and lack of pliable chondral cartilage in acquired auricular defects, surgical results may be inconsistent with decreased patient satisfaction [93]. On the contrary others have advocated for prosthetic use only in the setting of failed autologous reconstruction [94]. In a study by Braun

Fig. 5.1 Despite preoperative declaration that he would desire a prosthesis after total auriculectomy, this patient, like many others, readily adjusted to the loss of an external ear and never sought prosthesis creation

et al., 45 of 65 reconstructed patients who underwent total auricular reconstruction with porous polyethylene were adults, and overall patient satisfaction was 72.7% (Glasgow Benefit Index) [95]. In another study of adult microtia patients who underwent autologous rib reconstruction, overall patient satisfaction was 90% (author's independent questionnaire) [96]. Taken together, all options for aesthetic rehabilitation following auriculectomy should be considered on an individual basis as no definitive superiority of one approach over another has been determined. Multiple options are available for initial coverage of the skin defect after total or subtotal auriculectomy, and most will depend on the patient's surgical defect and body habitus. Cervical rotation maintains local skin with similar color and appearance, but may not be adequate for some defects. Regional flaps including supraclavicular, submental, pectoralis major, latissimus dorsi, and lower island trapezius flaps are all reasonable options depending on the size of the cutaneous defect and depth of the soft tissue and bone loss. For deeper defects (such as loss of lateral temporal bone, parotid and surrounding tissues), free flaps are ideal, and the thigh, rectus, and lateral arm are excellent donor sites. The lack of a subcutaneous muscular pedicle that is present in the thicker regional flaps is very appealing in that it avoids both the visible bulk of the pedicle causing asymmetry of the neck and the physical tethering of the head to the flap origin site. The additional benefit of perforator-based thigh and rectus flaps is that the long-term appearance can be well predicted at the time of surgery, because there is not a large muscle component that may atrophy. In the obese patient, flaps that are traditionally used for their thinness such as the radial forearm free flap and medial sural artery perforator flap may provide enough bulk. The goal is to have a natural contour to the side of the face and neck if no prosthesis is present, but not so much bulk that it would be prohibitive of prosthesis placement. Placement of bone-anchored abutment for a prosthesis and bone-anchored hearing aid placement can be carried out at the time of oncologic surgery, and preoperative consultation with the prosthetist is of great benefit.

The term "maxillectomy" is a broad one and describes the removal of a portion of the maxilla, but fails to indicate the extent resected. A maxillectomy defect can range from a small portion of the nasal floor/palate with no visible external defect to a large midface resection with devastating disfigurement. All other ablative procedures described in this chapter have no identifiable correlations between defect size and quality of life; however maxillectomy is the exception to the rule [97–99]. Obturator prostheses are popular options for palate defects and seal oroantral fistulas to improve hypernasality and nasal regurgitation of oral contents. When facial skin and/or underlying bone are resected, cosmetic prosthetics may be applied to aid in camouflaging a defect. Surgical reconstructive options include pedicled (i.e., temporalis muscle) and free flaps (i.e., radial forearm with or without bone, anterolateral thigh, scapula, fibula), with selection dependent upon patient factors and defect size, shape, and structure. Obturators carry an excellent record of high patient functional satisfaction [99, 100]. Given that they dwell within the oral cavity, they are easily concealed by their wearers and do not attract significant attention. The obvious additional benefit of restoring normal-appearing dentition cannot be overstated. Cosmetic concerns are noted when an ablation defect involves the mid-

face bony structure and/or skin. Patients emotional struggle is considerably greater in this situation; one described in an interview, "my ward nurse said Frankenstein couldn't have made a worse-looking monster" [101]. In this setting, facial prostheses are particularly useful, with better outcomes noted when adequate residual bone stock is available for abutment placement [102]. When defects are too large to retain a prosthetic alone, free flaps and prosthesis use may be combined to achieve better aesthetic and functional outcomes [103–106]. Only one study to date has compared obturation with free tissue reconstruction quality of life measures that include social-emotional functional domains. Breeze et al. found no significant differences between obturator users and free flap patients when examining social-emotional functional domains in maxillectomy patients of varying defect sizes (University of Washington Quality of Life Questionnaire, $p = 0.929$) [107]. While surgical defects created by maxillectomy can be distressing to those affected, several options for aesthetic rehabilitation exist. With careful discussions with patients about desired vs. anticipated outcomes, coordination of reconstruction using surgery, prosthetic use, or both can be utilized with good aesthetic satisfaction.

It is worth mentioning two studies that have examined prosthesis use among multiple subsites. In the largest study of facial prosthetic users by Dings et al., 52 patients who used orbital, nasal, or auricular prostheses were surveyed regarding satisfaction with their respective devices. Nasal prosthesis wearers noted statistically significant worse self-image compared to the other groups and felt that strangers were able to frequently discern the presence of a prosthesis in social interactions ($p = 0.01$). Overall, while some reported decreased mood (25%) and a negative influence on social activities (13%), patients were satisfied with their devices, evidenced by daily wear of 18, 14, and 14 hours per day for orbital, nasal, and auricular prostheses, respectively. In another study that evaluated 35 wearers of the 3 types of prosthetics, those that used secured implants felt that others noticed their prostheses less often (16 vs. 38% and 95% vs. 75%, respectively) and use of their prostheses decreased self-consciousness compared to those that used adhesive [108].

While ablative surgeries involving the eye, nose, maxilla, and ear carry significant disfiguring potential, their aesthetic rehabilitation options, whether reconstructive, prosthetic, or a combination of the two, provide dramatic benefit and result in comparatively less psychosocial distress when compared to other head and neck resections.

Donor Site Morbidity

Most of this chapter has focused on disfigurement in the head and neck region, while many of the reconstructive methods discussed rely on tissues outside of the head and neck. These various donor sites also contribute to the disfigurement of each patient and may even rival the head and neck disfigurement in the patient's mind. The preoperative discussions mentioned above should incorporate the details of the potential donor sites for reconstructive tissue harvest. The patient's social and

vocational activities are a useful guide to knowing which donor sites will be readily visible to the patient alone and those that will be visible to others. It is a rare patient whose radial forearm free flap donor site will not be seen by others, while for many patients a thigh, rectus, pectoralis, or subscapular system donor site may never be seen by anyone outside their own household, and the patient's own perception of these defects becomes paramount. This is illustrated best in considering the pectoralis major donor site in women. The breast plays an important part in the self-image of many women [109], and even if no persons other than the patient will view the scar and asymmetry present, it can have dramatic impact. Some patients recognize this preoperatively and even go so far as to refuse consent for that procedure. In others, modifications such as inframammary crease incisions and modified skin paddle position to blend with that incision may suffice to limit the psychological impact of a change in the breast appearance. At other sites, the difference between primary closure of a donor site and the need for a skin graft may affect the conspicuousness of the donor site, as well as adding an additional scar from skin graft harvest. All of these factors should be discussed with the patient preoperatively.

Posttreatment Postural Changes

Deforming musculoskeletal changes of the neck, shoulders, and chest may occur after surgery and/or radiation. Radical or modified radical neck dissection sacrifice of the sternocleidomastoid (SCM) muscle and/or spinal accessory nerve (CN XI) leads to well-established functional deficits [110, 111]. Visible physical deformities may occur due to resection of muscle, muscle that is present but atrophies secondary to denervation, or fibrosis. In cases where CN XI is sacrificed but the SCM is preserved, changes to the trapezius result in characteristic physical changes including shoulder droop at rest [112], loss of the sloping contour of the shoulder (resembles a right angle) due to trapezius atrophy (Fig. 5.2), and flaring of the scapula due to failure of the trapezius stabilization [113]. Removal of all or part of the SCM muscle is occasionally necessary during neck dissection. Cosmetically, this may result in variable degrees of neck volume loss depending upon the extent of muscle bulk in the contralateral neck and body habitus (may be better concealed in patients with large neck circumferences). While functional changes are beyond the scope of this chapter, SCM fibrosis (whether by resection or denervation) may cause lateral neck extension and head rotation toward the operative side in unilateral cases, potentially resulting in an unnatural resting head position. Cases of bilateral SCM sacrifice or denervation may cause anterior head carriage due to loss of extension of the upper cervical spine and loss of flexion in the lower cervical spine [114, 115].

Radiation fibrosis is a progressive process of sclerosis and can affect any soft tissue structure. Radiation-induced musculoskeletal changes may occur due to direct damage to muscle or secondarily by injury to supplying nerves or blood vessels. In general, this leads muscle to become poorly functional and often aberrantly positioned. Historically, wide-field radiation treatments to the neck and chest in

Fig. 5.2 Obvious disfigurement is present with primarily musculoskeletal surgery despite very high compliance with postoperative physical therapy in this patient. A myofascial pectoralis flap was used to protect carotid reconstruction after radical neck dissection. In addition to the loss of unilateral neck volume, the shoulder and trapezius asymmetry are clearly evident, as is the donor site defect

Hodgkin lymphoma resulted in characteristic changes including cervical kyphosis, head protrusion, central collapse of the anterior chest, and internal rotation of the humeral head(s) [116]. These changes are also commonly observed in patients irradiated for head and neck cancers [117] and so common to practitioners treating head and neck cancer patients that they may overlook the importance of addressing this impact. This type of disfigurement can contribute to pain syndromes due to strain placed on surrounding shoulder and paraspinal muscles [116] and consequent functional impact as well.

Postural changes resulting from treatment of head and neck cancer may be expected to be more functional than aesthetic in nature, especially when compared against other disfigurements described here. However, in a recent study by Eickmeyer et al., neck dissection patients reported significant differences in subjec-

tive disfigurement due to shoulder abduction deficits. This applied even in cases where CN XI was preserved, implying that although they are comparatively smaller disfigurements, postural changes may still have significant negative impact on the patient [118].

The oncologic surgeon plays a greater role in avoidance of these disfigurements than the reconstructive surgeon, as most of the postsurgical fibrosis is due to normal tissues that are removed or dissected. While some normal structures may need to be resected to cure a patient's cancer, this is the only situation where normally functional tissue should be sacrificed. Maintenance of the native neural, vascular, and muscular structures in the neck can be safely achieved in most neck dissections. When additional care is taken to preserve not only the neck musculature, but its investing fascia, the resultant fibrosis and disfigurement secondary to limitation of movement should be minimized. In practice this is difficult to study and to enact surgically. Preservation of the deep neck fascia overlying the splenius capitis, levator scapulae, and scalene muscles is relatively easy to perform (even early in one's surgical training). However, maintaining a fascial layer around the sternocleidomastoid to avoid direct exposure of its muscle fibers and consequent scarring of those fibers may be difficult even for an experienced surgeon at times, particularly in the presence of nodal disease in the neck. Similarly, the preservation of the vessels and fascia around the spinal accessory nerve may well limit transient paresis, but is not a simple prospect when the lymph nodes of levels IIA and IIB are to be comprehensively removed.

Treatment of musculoskeletal changes resulting from surgical and radiation treatment of head and neck cancers is very difficult to complete as fibrosis is an irreversible process. Head repositioning devices are available for pain, but do not reverse disfigurement related to these changes [116]. Prevention of these changes is the best modality and can be accomplished by early exercise programs during radiation/after surgery (in both nerve and muscle-sparing and sacrificing surgeries) [119] and deintensified radiation protocols whenever appropriate [120].

Lymphedema

Lymphedema represents one of the more difficult late toxicities for patients having survived their head and neck cancer (Fig. 5.3). Lymphedema is defined as fibrosis and retained lymph causing edema of the treated soft tissues [121, 122], most commonly observed in survivors having received combined chemotherapy and radiation therapy. From the surgical standpoint, the goal of the oncologic surgeon during neck dissection is the comprehensive removal of the fibrofatty tissue containing the lymph nodes of the neck levels being dissected; an oncologically successful surgery, by definition, should result in lymphedema. This under-recognized and undertreated toxicity results in undesirable chronic swelling as well as color and quality change to the treated skin and underlying tissues. The physical findings of lymphedema are thought to be secondary to accumulation of lymph within interstitial spaces, an

Fig. 5.3 Extreme lymphedema. This gentleman was referred for a second opinion to discuss potential alternatives to hospice for what was presumed to be extensive cancer recurrence involving the entire tongue and lower lip despite negative biopsies. In reality, the dramatic and progressive facial, lip, and intraoral swelling were lymphedema secondary to prior surgery and radiation. The patient had significant subjective improvement in appearance and quality of life after the first 6 weeks of CDT as well as functional improvement

important target during therapy. Lymphedema has been associated with poorer quality of life, increased function impairment, and increased symptom burden overall [123–126].

For long-term survivors of head and neck cancer, lymphedema can be a chronic condition for the remainder of their lives. Although currently thought of as incurable, there are several strategies to improve symptoms for these patients. Currently, level 1 evidence is lacking to support any single therapy or protocol; however data does support improvement with early identification and timely intervention [127]. The current standard of care treatment is "complete decongestive therapy" (CDT) that involves a combination of manual lymph drainage, compression techniques, exercises, skin care, education, and other related self-care [128, 129]. The goal of this therapy is to manage lymphedema as a chronic condition and to prevent chronic fibrofatty changes to the underlying soft tissues.

Currently, the Oncology Nursing Society's Putting Evidence into Practice protocol has rated CDT as "recommended for practice" with the highest level of evidence [130]. However, the current data this recommendation is based on comes from extremity/non-head and neck lymphedema. That being said, recent literature in head and neck survivors shows promise with retrospective data showing about two-thirds clinically significant response to CDT [131]. Posttreatment interview of patients has also shown a 90% physical and 70% psychological benefit to lymphedema therapy. Several barriers to treatment were also identified by this study however [127].

Cosmetic and functional improvement with lymphedema can be addressed surgically as well. Techniques such as liposuction, autologous fat transfer or augmenta-

tion, and local, regional, and free flap reconstruction can benefit patients as well [132]. Liposuction, particularly in the submental region, can significantly improve patients' self-perception as well as objective scoring of appearance [133]. Similarly augmentation with fat for cosmetic and functional purposes has great utility within the facial soft tissues, neck, parotid bed, and vocal cords in differing circumstances [134–136]. Lastly, lymphatic transfer surgery and flap reconstruction or revision can be used in certain settings; however this remains patient- and case-specific. Over the decades, the progression from radical neck dissection to modified radical neck dissection and subsequently selective neck dissections has lessened the amount of normal lymphatic structures that are sacrificed. If the time comes that sentinel lymph node biopsy is found to be oncologically equivalent to elective neck dissection in clinically N0 patients, the surgical contribution to lymphedema may be greatly eliminated (in those found to be pathologically N0). As neck dissection remains the primary surgical treatment of the neck nodes at this time, the planning of the surgical incision may be the greatest impact the resecting surgeon has on postoperative lymphedema. While the loss of deep lymphatics remains stable, the use of incisions with a primarily vertical orientation may lessen the impact of the subcutaneous venolymphatic drainage on a patient's lymphedema. Even unradiated patients often have supraincisional lymphedema with horizontally oriented scars, presumably from the loss of geotropic flow of lymph and blood.

Conclusion

The primary goal of head and neck oncologic surgery remains the clearance of malignant disease to prolong disease-free survival. Unfortunately, the success of this objective often results in significant head and neck disfigurement with dramatic impact on a patient's non-oncologic outcomes. Poor aesthetic outcomes may induce marked distress to affected patients, decreasing psychosocial quality of life. In all surgical cases, the surgeon must have thorough and frank discussions with the patient and his/her family on expected defect(s), reconstructive options, and expected outcomes from these. With adequate preparation from counseling and preoperative planning standpoints, disfigurement can hopefully be minimized with optimal oncologic and psychosocial success.

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