Dental Care for Patients with Disabilities

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Faculty Disclosure

Contributing faculty, Mark J. Szarejko, DDS, FAGD, has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

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The division planner and director have disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Audience

This course is designed for nurses, nurse practitioners, nursing home personnel, physical therapists, occupational therapists, and caregivers involved in assessing and promoting optimum oral care for special needs patients.

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Course Objective

The purpose of this course is to focus awareness upon the difficult oral health issues that patients with disabilities face on a daily basis and to provide healthcare professionals with the necessary information to improve patients' oral and systemic health.

Learning Objectives

Upon completion of this course, you should be able to:

1. Outline the chronic oral health issues caused by Sjögren syndrome.
2. Describe the oral health issues associated with the systemic and discoid forms of lupus erythematosus.
3. Discuss the diverse variety of opportunistic oral infections that occur in patients with HIV/AIDS.
4. Outline how immunosuppression for patients with organ and bone marrow transplants and from chemotherapy affects short-term and long-term oral health care.
5. Review oral health considerations for patients with Parkinson disease, cerebral palsy, and spinal cord injuries, and describe treatment modifications for home care and in-office dental care.
6. Identify the varying degrees of physical impairment experienced by stroke victims and techniques that allow them to maintain oral hygiene.
7. Describe the special oral health issues encountered by cognitively impaired patients, particularly those with Down syndrome or Alzheimer disease.

Sections marked with this symbol include evidence-based practice recommendations. The level of evidence and/or strength of recommendation, as provided by the evidence-based source, are also included so you may determine the validity or relevance of the information. These sections may be used in conjunction with the course material for better application to your daily practice.

INTRODUCTION

In dentistry, patients with disabilities include those for whom a medical, physical, developmental, mental, or cognitive condition complicates their ability to maintain optimal levels of oral hygiene. As a result, these patients are at increased risk for caries and periodontal disease; the overall health of the oral mucosal tissues and the oral and maxillofacial complex can also deteriorate. According to some estimates, there are nearly 40.6 million people in the United States who are considered to have one or more disabilities [1]. Some of the conditions associated with patients with disabilities are also associated with the chronic health issues of the aging process. Because the older population in the United States is expected to more than double between 2016 and 2060, this is an area of particular concern [2].

Because a complete discussion of all debilitating conditions is not possible in this course, representative conditions with diverse origins will be described. This includes autoimmune, immunosuppressive, neurologic, and cognitive conditions. Autoimmune conditions such as Sjögren syndrome can decrease salivary production and cause a long-term challenge to oral health. Immunosuppression, caused by human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) or resulting from the use of certain medications, can cause opportunistic infections of bacterial, fungal, or viral origin. Patients who have Parkinson disease, cerebral palsy, or spinal cord injuries may develop neuromuscular control problems that preclude their ability to maintain basic oral hygiene. Developmental disabilities, such as Down syndrome, and acquired cognitive problems, such as Alzheimer disease, pose an ongoing challenge when maintaining oral hygiene, and caretaker assistance is usually required. Anticoagulant therapies used in the treatment of cardiovascular disease require special management when oral or periodontal surgery is required.

This course will discuss the oral effects associated with these conditions and the indirect and direct complications associated with the medications used in their treatment. Approaches to maintaining oral health, including at-home and in-office modifications, will also be outlined.

AUTOIMMUNE DISEASES

SJÖGREN SYNDROME

Sjögren syndrome is a common autoimmune disease that occurs in two different forms. Primary Sjögren syndrome involves the lacrimal glands (keratoconjunctivitis sicca) and the salivary glands (xerostomia). The secondary form presents with these problems and a diagnosed systemic connective tissue disease such as rheumatoid arthritis or fibromyalgia. Sjögren syndrome develops slowly over many years, and diagnosis is made an average of 2.8 years after the onset of symptoms [3]. It is estimated that 4 million individuals in the United States have this disease, with an additional 2.5 million currently undiagnosed. There is a 9:1 female-to-male ratio [4]. While Sjögren syndrome can occur at any age, patients in their fourth and fifth decades of life are most frequently affected. The etiology of this autoimmune disorder is not well understood. Histopathologic examination reveals an infiltration of lymphocytes that causes chronic inflammation within the salivary glands and the lacrimal glands [5]. The secreting capacity of the salivary glands is diminished at rates that vary among patients. Similarly, the lymphocytic infiltration and subsequent proliferative epithelial response constricts the ducts. Decreased salivary production and flow results in xerostomia (dry mouth). The initiation of the syndrome is believed to be triggered by environmental factors, possibly viruses [4]. Because women are more likely to be affected, it is hypothesized that female sex hormones may influence the onset or presentation of the disease. The changes are irreversible, and with no current cure for Sjögren syndrome, patients are affected by numerous long-term problems of the oral and maxillofacial complex originating from xerostomia.

Problems Associated with Xerostomia

Saliva plays a critical role in the health and maintenance of the oropharyngeal region. A sustained reduction of salivary production in patients afflicted with Sjögren syndrome increases the risk for dental caries and opportunistic infections, such as candidiasis, and causes problems with the oral mucosa such as mucositis and glossitis. Speaking, swallowing, and eating can become difficult tasks under these circumstances.

The adequate production of saliva is an essential component in the self-cleansing action of teeth, as cariogenic bacteria are less adherent to the surfaces of teeth when a salivary layer is present, which minimizes their physical retention. Saliva also has a buffering capacity that raises the oral pH and creates a less acidic oral environment. When salivary production decreases, its buffering ability is also diminished and the oral pH is lower. The acidic oral environment that develops is more favorable to the proliferation of cariogenic bacteria [6; 7].

Patients with secondary Sjögren syndrome who have diseases such as rheumatoid arthritis or fibromyalgia can have additional problems with the proper maintenance of their oral hygiene. Musculoskeletal conditions such as arthritis can interfere with the dexterity and coordination necessary for basic oral hygiene techniques, such as brushing and flossing. Patients with gingival recession and circumferentially exposed root surfaces have a greater surface area of vulnerable tooth surfaces exposed to this caries-prone environment.

Miscellaneous Oral Problems

The reduction of salivary production for patients with Sjögren syndrome causes a commensurate reduction in the salivary immunoglobulins and enzymes that act to decrease the pathogenicity of organisms of the oral microflora. Among these, overgrowth of the fungal organism *Candida albicans* causes candidiasis in many of these patients. This fungal organism thrives in an oral environment that is less lubricated and more acidic. Antifungal rinses such as nystatin are usually effective to treat candidiasis in patients with Sjögren syndrome. Cases that are unresolved require systemic antifungal therapy with agents such as fluconazole [8]. Antifungal troches that must be dissolved by the patient's saliva may be difficult for these patients to use.

In addition, it is important to remember that the acrylic bases of prostheses (e.g., partial or complete dentures) contain microscopic porosities and surface irregularities that can harbor candidal organisms. These appliances should also undergo antifungal treatment that is compatible with the materials of which they are composed. This is important to prevent reinoculation of the tissue-bearing mucosal surfaces with fungal organisms. Candidal infections recur in these patients because the oral conditions conducive to the initial outbreak do not resolve.

Dental Treatment Considerations

Dental treatment for patients with Sjögren syndrome involves both a proactive and preventive approach. These patients require more frequent recall appointments to evaluate their home care and to restore carious lesions that may develop between recall appointments. Oral hygiene instructions tailored to the patient's individual needs should be provided. Patients with arthritis or fibromyalgia may benefit from toothbrushes with modified handles or grips and special flossing aids to provide basic oral home care in the presence of compromised dexterity. Patients should also receive nutritional counseling that emphasizes a low-sugar diet to decrease the risk of extensive caries.

Concentrated preparations of 5,000 ppm sodium fluoride that can be applied directly to the teeth with a toothbrush or delivered via custom fluoride trays are an essential part of caries reduction; over-the-counter fluoride rinses do not provide the protection required to manage the increased risk. Sodium fluoride is preferred over stannous fluoride as the latter has a metallic taste, may cause a burning sensation, and can stain enamel [9]. Antimicrobial mouth rinses such as 0.12% chlorhexidine gluconate may

be used to decrease the bacterial growth associated with caries and periodontal disease. Chlorhexidine has substantivity, the ability to adhere to the gingiva, mucosal tissues, and teeth for prolonged periods of time, which differentiates it from other commercial preparations. Patients should be advised that chlorhexidine will stain teeth and existing bonded (composite) restorations. A prophylaxis will remove the stains from the unrestored surfaces of the teeth, but stains in the bonded restorations may require their replacement.

The Sjögren's Syndrome Foundation asserts that chlorhexidine administered by varnish, gel, or rinse may be considered in patients with Sjögren syndrome with dry mouth and a high root caries rate.

(https://www.sjogrens.org/sites/default/files/inline-files/SF_PCG-Oral_0.pdf. Last accessed April 21, 2022.)

Strength of Recommendation: Strong

Patients who wear complete or partial dentures may experience discomfort resulting from the decreased amount of saliva. The mucosal tissues that form the foundation for the prosthesis can become ulcerated, which can minimize or preclude their use. Commercial salivary substitutes may provide some relief, but their effects are temporary. Medications such as pilocarpine and cevimeline are cholinergic agonists and can stimulate salivary flow but only in the exocrine tissue and ducts that have not been destroyed by the autoimmune process [10]. Soft reline material may help to reduce the trauma to the desiccated oral mucosa.

In addition to the effects of the disease process, patients with Sjögren syndrome may be taking medications for other chronic illnesses, and many of these can cause xerostomia. Clinicians should determine if an alternative medication may be prescribed for which the side effect of xerostomia can be eliminated or reduced.

Treatment and Prognosis

As noted, there is no cure for Sjögren syndrome [11]. Patients with the condition will display varying degrees of morbidity and a spectrum of oral and maxillofacial complications. Among the most serious complication associated with primary Sjögren syndrome is the development of certain types of lymphomas [12]. Dental treatment should be centered on a preventative and proactive approach that mandates more frequent recall appointments and intensive patient involvement with their daily oral hygiene regimen. All clinicians involved in the oral health and overall physical health of these patients should strive to provide a continuity of care that minimizes the discomfort and complications of the disease and improves patients' quality of life [7].

LUPUS ERYTHEMATOSUS

Lupus occurs in several forms, the two most common being discoid lupus erythematosus (DLE) and systemic lupus erythematosus (SLE). DLE affects the skin and mucosa, usually without systemic involvement. SLE can affect multiple organs and systems and is the more serious form of the disease. The underlying basis for lupus is the formation of autoantibodies, especially to DNA and other nuclear material. The precise antigenic stimulus that initiates the formation of these autoantibodies is unknown. The deposition of the antigen-antibody complex into varied tissues and the resultant inflammatory response is the pathophysiologic basis of SLE [13].

The lesions of DLE usually occur on the face, scalp, ears, and hands. These lesions can feature an erythematous area and scales that extend into hair follicles, causing follicular plugging. Although oral lesions are not a strict identifying feature of DLE, when they do occur the buccal mucosa and palate are areas of predilection. Oral lesions associated with DLE can feature irregular white borders and telangiectasia peripheral to a small atrophic area that contains white papules [14]. A biopsy may be required to differentiate the oral lesions of DLE from malignant lesions such as squamous cell carcinoma.

As noted, SLE is more virulent than the discoid form of this disease. It primarily occurs in women of childbearing age, with a 9:1 female-to-male ratio [15]. Improved treatment modalities have increased the 10-year survival rate to greater than 85%, and the survival rate at five years is 95% [16; 70]. Complications from infections, renal failure, and cardiovascular and pulmonary pathology are among the leading cause of death for these patients [17; 18].

A classic cutaneous manifestation of lupus, which occurs in approximately 30% to 40% of patients, is a butterfly-shaped (malar) rash that extends over the bridge of the nose and the cheeks. The degree of erythema accompanying this rash can range considerably. Oral lesions can be non-specific and can include ulcerations, petechiae, and erythematous lesions of varied morphology.

Dental Treatment Considerations

Patients with SLE have varying degrees of systemic involvement. Necessary modifications to dental treatment and the ability of the patient to maintain good oral hygiene will depend upon the systems affected and the degree of their involvement.

As with Sjögren syndrome, arthritis affects many patients with SLE and may compromise the dexterity needed for brushing and flossing. Toothbrushes with modified handles and flossing aids can improve the ability of these patients to maintain proper oral hygiene. More frequent recall appointments may be needed if patients with SLE afflicted with arthritis experience persistent difficulty in basic oral hygiene techniques.

Hematologic problems may also occur with SLE. Thrombocytopenia, a condition of decreased platelet count, may be present and is a concern for oral and periodontal surgery patients. Before these procedures are initiated, the patient's most recent complete blood count values should be assessed. If the platelet count is less than 50,000/mm^3, hemostasis can be compromised, and serious bleeding can occur [19].

Medications utilized in the treatment of SLE can have systemic ramifications and can require modifications for dental treatment. The salicylates and nonsteroidal anti-inflammatory drugs (NSAIDs) used to provide analgesia can also prolong the bleeding time. The degree to which this occurs may be clinically insignificant, but the synergistic effect can be a concern when considering oral or periodontal surgery for patients with SLE who experience thrombocytopenia. If an invasive dental procedure is indicated, it should be coordinated with the patient's physician.

Immunosuppressive medications such as azathioprine and cyclophosphamide are used in patients with SLE to decrease the autoimmune response that causes organ and system damage. Azathioprine can cause bone marrow suppression and decrease production of platelets and granular and agranular leukocytes [20]. If a patient with SLE takes these medications, his or her physician must be consulted before any oral or periodontal surgical procedure is begun. Concerns about postsurgical hemostasis and infections should be discussed. The dosage of this medication may need to be adjusted pending the laboratory values as determined in the complete blood count. Hepatotoxicity is also a potential effect of azathioprine. Many medications utilized in dentistry are metabolized in the liver, and their metabolism may be diminished in patients taking azathioprine, with the potential for toxic accumulation [21]. Laboratory values for liver enzymes and a liver biopsy may be required if there is any concern about diminished hepatic function. Cyclophosphamide can also cause diminished production of platelets and leukocytes, with associated concerns about hemostasis and postsurgical infections. Mucositis may also occur in some patients for whom cyclophosphamide is prescribed [22].

Systemic corticosteroid oral medications, such as prednisone and methylprednisolone, as well as injectable medications, such as dexamethasone and triamcinolone, are used in SLE patients to decrease the systemic inflammatory response and to suppress the cellular basis for the autoimmune dysfunction. Prolonged use of these medications can extend the healing time of surgical sites, increase the difficulty of detecting oral infections, and cause suppression of adrenal gland secretions. These are significant considerations before any oral or periodontal surgery is contemplated. Further, because many patients consider any dental treatment as a stressor, prolonged pharmacotherapeutic adrenal gland suppression can preclude the ability of this endocrine organ to secrete the appropriate hormones necessary for the physiologic adaptation to stress. A dose adjustment of these medications prior to dental treatment may be necessary to prevent an adrenocortical crisis. When used in conjunction with systemic corticosteroids, analgesics used for odontogenic pain, such as NSAIDs, can increase the risk of gastric ulceration. Another classification of analgesics may be needed [21].

Treatment and Prognosis

Currently, there is no cure for lupus erythematosus. Although there is no cure, there are several types of drugs available to aid in the treatment and management of secondary symptoms. Among these drug classes are NSAIDs, corticosteroids, antimalarials, and immunosuppressives. In cases of lupus-related severe kidney disease not helped by pharmacologic intervention or dialysis, kidney transplant may be necessary. The medications used to treat both forms of lupus can have numerous interactions with medications used for dental treatment and can adversely affect immunocompetence, hemostasis, and the ability to withstand stress.

IMMUNOSUPPRESSIVE CONDITIONS

HIV/AIDS

The oral complications discussed in this section are mainly evident when the progression of HIV infection has reached the level at which designated opportunistic illnesses and infections fulfill the criteria for the diagnosis of AIDS. Patients with AIDS encounter unique oral problems, and special considerations for their dental treatment are often necessary.

The defining characteristic of HIV disease is the immune deficiency state caused by ongoing viral replication and cell-to-cell transmission within lymphoid tissue. With chronicity of infection there is a progressive depletion of CD4 (helper-inducer) lymphocytes, the very T lymphocyte cohort whose function it is to direct other cells in the immune system, and to orchestrate the inactivation of virus antigen. The result is a depressed T lymphocyte functional capacity, characterized by depletion of helper T cells (T4), impaired killer T cell activity, and increased suppressor T cells (T8). In persons with intact lymphocyte immune systems, the normal number of CD4 T cells ranges from 600 – 1,200 cells/mcL.

Symptomatic illness can be expected to supervene as the CD4 count declines to a level less than 200 cells/mcL, as this correlates with severe immunodeficiency. The Centers for Disease Control and Prevention defines late-stage HIV infection as AIDS on the basis of two criteria: CD4 count less than 200 cells/mcL or a characteristic AIDS-defining illness such as pneumonia, central nervous system toxoplasmosis, or other opportunistic infections or tumors (Kaposi sarcoma). The natural history and the prognosis for the patient with chronic HIV infection have been dramatically altered by antiretroviral therapy, especially by the use of combination antiretroviral therapy (cART).

Oral candidiasis is the most frequent opportunistic oral infection in patients with HIV/AIDS, with a very high occurrence in this population [23]. When *C. albicans* becomes an opportunistic oral pathogen, the extent and virulence of the infection increase as the CD4+ lymphocyte count decreases. Candidiasis can extend to the pharynx and esophagus and ultimately result in a fatal septic termination. Oral or intravenous antifungal medications such as fluconazole and itraconazole are used when advanced fungal infections occur. Caution must be exercised when other medications are prescribed, as antifungal medications can have numerous problematic drug-drug interactions. Invasive dental treatment should be avoided during an outbreak of oral candidiasis as surgical sites can become a means of systemic fungal dissemination.

EVIDENCE-BASED PRACTICE RECOMMENDATION

According to the Centers for Disease Control and Prevention, the National Institutes of Health, and the HIV Medicine Association of the Infectious Diseases Society of America, oral fluconazole at 100 mg once per day is considered the drug of choice to treat oropharyngeal candidiasis in patients with HIV/AIDS, except during pregnancy. One to two weeks of therapy is recommended for oropharyngeal candidiasis; two to three weeks of therapy is recommended for esophageal disease.

(https://clinicalinfo.hiv.gov/sites/default/files/guidelines/documents/adult-adolescent-oi/guidelines-adult-adolescent-oi.pdf. Last accessed April 21, 2022.)

Strength of Recommendation/Level of Evidence:
AI (Strong recommendation based on one or more randomized trials with clinical outcomes and/or validated laboratory endpoints)

Periodontal disease can manifest aggressively in patients with HIV/AIDS, especially those who are extremely immunocompromised. Most forms of periodontal disease progress slowly and asymptomatically. As the immunocompetence of patients with HIV/AIDS deteriorates, periodontal pathogens can accelerate the loss of soft tissue attachment and of the alveolar bone. Necrotizing gingivitis and periodontitis (previously called HIV-associated gingivitis and periodontitis) can be of such severity that loss of alveolar bone support requires the extraction of the involved teeth. Extension of the periodontal pathogens into the adjacent mucosa and bone can cause a necrotizing stomatitis, which can destroy these tissues and advance to a life-threatening infection [24]. It is critical for all HIV patients to maintain regular recall appointments during the entire course of their illness. Initial periodontal problems that can be treated conservatively with an early diagnosis will become increasingly difficult to treat and potentially refractory to periodontal treatment during the progression of the disease.

Before treatment such as oral or periodontal surgery and root planing and curettage is started, the overall health status of the patient should be assessed. The most recent laboratory results, including complete blood count, CD4+ levels, and viral load, must be known before any invasive treatment is attempted. Some patients with AIDS develop thrombocytopenia, and postsurgical hemostasis becomes an issue. Similarly, patients may develop neutropenia, in which the production of neutrophils and their role in a healthy immune system decreases. These patients can be at an increased risk of postoperative infections. The infections can become life-threatening even after basic surgical procedures. Invasive procedures may require postponement until the appropriate hematologic values are attained. Antibiotics used prophylactically and postsurgically, by oral or parenteral means, are further considerations.

As HIV progresses, there will be a point, determined by the CD4+ and viral load levels, when the patient is placed on cART. Medications from different classes of the antiretroviral drugs are combined to decrease the viral load and increase the CD4+ level; some of these medications can interact with those used in the scope of dental practice.

Acetaminophen, alone or in combination with narcotics such as codeine or hydrocodone, is frequently used to control dental and postsurgical pain. If acetaminophen is combined with zidovudine, a nucleoside reverse transcriptase inhibitor that may be included in the cART regimen, there is potential to accentuate the neutropenia and anemia caused by zidovudine. NSAIDs such as ibuprofen and naproxen are also commonly utilized to control postprocedural dental pain. These medications can alter the metabolism of the nucleotide tenofovir and can also increase the risk for renal complications [25]. When medications are prescribed for systemic diseases, clinicians have the responsibility to be cognizant of their potential interactions with medications utilized for dental treatment. Hepatic and renal diseases can alter the clearance of many medications.

Treatment and Prognosis

There is no cure for HIV/AIDS at the present time. Proactive use of cART has been successful in increasing the lifespan for these patients; however, these medications can have multiple side effects and require a significant number of pills be taken daily, which can decrease patient compliance. Dental treatment should be initiated in the earliest known stage of HIV infection, during which time dental caries, periodontal problems, and oral pathology can be treated while the patient's immune system is capable of withstanding such treatment. The frequency of recall appointments should reflect the oral health concerns and the degree of complications associated with advancing HIV disease.

ORGAN AND BONE MARROW TRANSPLANTATION

Solid organ and bone marrow transplants are being done with increasing frequency. These are complex procedures with initial and long-term challenges. Potent immunosuppressive medications are prescribed for these patients to decrease the risk of rejection of the transplant. These medications can have pronounced oral effects and can subject the patient to opportunistic oral infections, which can have significant morbidity and even result in death.

Cyclosporine is a commonly used immunosuppressive agent prescribed for organ transplant patients. Systemically, it can induce changes in neural, renal, and hepatic function and can cause hypertension [26]. Potential oral effects include gingival hyperplasia, oral ulcers, xerostomia, and increased susceptibility to opportunistic oral infections. Gingival enlargement usually occurs within the first three months of cyclosporine administration and can be potentiated by the coadministration of medications such as the calcium channel blocker nifedipine, used to treat hypertension. The hyperplasia can involve the interdental papillae and the marginal and papillary tissues [27]. These tissue changes can complicate patients' ability to maintain ideal oral hygiene and increase the incidence of periodontal disease.

Another potent immunosuppressive medication that is used for organ transplant patients is tacrolimus. The increased risk for opportunistic infections associated with cyclosporine is also a potential problem with tacrolimus. Renal toxicity, anemia, and hyperkalemia are among the other potential side effects [28]. However, the associated gingival hyperplasia and hypertension that may occur with cyclosporine are not encountered with tacrolimus.

Acute periodontal infections develop more readily, as pharmacologically induced immunosuppression can decrease the host response to periodontal pathogens. The opportunistic infections that occur with the use of medications such as cyclosporine may last longer and be more virulent than those in non-immunocompromised patients. *C. albicans* is a common cause of candidiasis in many post-transplant patients. Systemic antifungal agents such as ketoconazole and voriconazole are used when extensive or refractory candidiasis is not resolved with topical agents such as nystatin. These medications may increase the serum concentrations of cyclosporine and tacrolimus, so they should be only used with caution after medical consultation.

Aspergillus is another fungal species that can demonstrate a virulent and even lethal course in the immunosuppressed transplant patients. This fungal pathogen is seen in 5% of liver, lung, and heart transplant patients but is less common in kidney transplant patients [29]. Systemic antifungal medications that are effective against *Aspergillus* spp. include itraconazole, posaconazole, voriconazole, caspofungin, and micafungin [28; 30]. The use of these medications may increase the serum levels of cyclosporine; blood levels of the immunosuppressive agent should be monitored carefully.

Oral and maxillofacial viral infections also can occur more frequently and require an extended healing period for post-transplant patients. Herpes simplex virus 1 (HSV-1) causes outbreaks of recurrent herpes labialis (cold sores). These lesions can become more expansive in immunocompromised patients and can even cause herpetic keratoconjunctivitis, which can lead to blindness. The combination of stress associated with ongoing medical issues and medically induced immunosuppression contributes to these recurrent outbreaks.

The varicella zoster virus, which causes chickenpox in children and young adults, can also be reactivated in the adult years as the herpes zoster virus, which causes shingles. Oral and maxillofacial involvement follows the distribution of the mandibular, maxillary, and ophthalmic divisions of the trigeminal nerve. These vesicular lesions can be cutaneous or intraoral and are much more extensive then than those of HSV-1. Immunosuppressed patients may have prolonged and more aggressive outbreaks of shingles. Intraoral involvement can progress to necrosis of the mucosa and alveolar bone, with tooth loss as a potential sequela.

Topical or oral antiviral agents such as acyclovir or valacyclovir can expedite the healing of recurrent herpes labialis lesions. Extensive shingles lesions may require intravenous acyclovir to promote healing. Because the immunosuppressed status of transplant patients will continue for life, viral outbreaks are likely to recur. Many patients with shingles develop a painful condition called postherpetic neuralgia (PHN) at the area where the lesions occurred. Narcotic analgesics and antidepressants are prescribed for this chronic, painful condition. If a patient has PHN and is taking these medications, prescribing additional narcotic analgesics for odontogenic pain or postsurgical analgesia should be avoided.

A special concern for transplant recipients is the increasing chance for the development of certain malignancies over time [31]. Squamous cell carcinoma (particularly occurring on the lip), basal cell carcinomas, and Kaposi sarcoma occur with increasing incidence post-transplantation [26]. The range of incidence extends from 10% 10 years after the transplant to 40% after 20 years [32]. The viral DNA of human papillomavirus (HPV) has been isolated from some of these lesions. The chronic immunosuppressive state of transplant patients may allow the HPV to have a role in the development of these lesions [33]. This potential for oral malignancies mandates that patients who have received transplants be educated regarding the necessity for regular, comprehensive oral examinations including oral and maxillofacial cancer screenings.

The first bone marrow transplant was performed in 1958 [34]. This procedure is utilized for patients afflicted with myeloproliferative disorders, including aplastic anemia, chronic myelogenous leukemia, and acute leukemia that has been refractory to chemotherapy treatment. Prior to the transplant, procedures in varied combinations such as chemotherapy, total body irradiation, and the use of immunosuppressive medications are used to kill cancer cells and to decrease the immune response that can cause rejection of the transplanted tissues. This rigorous pretreatment regimen can reactivate the herpes simplex virus in as many as 80% of patients [35]. Acyclovir is used prophylactically for bone marrow transplant patients who test positive for antibodies to herpes simplex virus.

Chemotherapy is used in conjunction with surgery and radiotherapy for varied systemic and organ-based malignancies. These medications have a low margin of safety and target rapidly dividing cells, which includes both the malignant cells and healthy cells of many tissues. The cells of the oral mucosa are rapidly dividing and may be damaged during chemotherapy. The resulting oral mucositis features painful mucosal ulcerations that can also serve as a means of systemic dissemination for oral pathogens. The alteration of the ability of the bone marrow to produce an adequate quality and quantity of platelets, erythrocytes, and granular and agranular leukocytes can make these patients prone to opportunistic infections and bleeding problems. Fortunately, these problems resolve after the cessation of chemotherapy.

Dental Treatment Considerations

A proactive course of dental treatment prior to transplant surgery and chemotherapy is mandatory to maintain optimal oral health and to prevent dental pathology from developing into problems that can become life-threatening. Patients who require an organ or a bone marrow transplant are chronically ill and may wait years before a transplant is available. The patient's physician should be consulted before any treatment is initiated; these patients are usually on several medications that can interact with those used for dental treatment. Patients with compromised liver and kidney function will have an altered ability to metabolize and excrete certain medications, such as local anesthetics, analgesics, and antibiotics. Decreased hepatic function can alter the production of coagulation factors, which can affect hemostasis for surgical procedures. Cardiac patients who are awaiting a heart transplant may be placed on anticoagulant therapy with medications such as warfarin, clopidogrel, or aspirin. NSAIDs can potentiate the anticoagulant effects of these medications and may cause internal bleeding. Alternative analgesics compatible with the patient's medical history and current medications should be utilized. When any dental procedure is planned in which hemostasis is a concern, clinicians should consult the patient's physician to obtain the most recent prothrombin time (PT) and international normalized ratio (INR).

Dental treatment should be designed to restore carious teeth or to extract those that cannot be restored or that the patient will not maintain upon their restoration. Similarly, teeth with periodontal problems that cannot be treated and maintained should be extracted. The long-term immunosuppressive concerns of transplant patients must be addressed before any invasive dental treatment is started. It is essential that surgical procedures are completed as far in advance as possible of the transplant surgery and subsequent immunosuppressive therapy. The frequency of recall appointments should reflect the patient's ability to maintain optimal oral hygiene via home care. Antibacterial mouth rinses such as 0.12% chlorhexidine gluconate can be an excellent supplement for an oral hygiene regimen that seeks to promote optimal periodontal health. Management of the patient before and after any transplant procedure should consist of patient education, motivation, and treatment that will allow the patient to achieve and maintain oral health as much as possible.

Treatment and Prognosis

Many factors can influence the survival rates of organ transplant patients. Unfortunately, many patients die waiting for a transplanted organ. The five-year survival rates for kidney and heart transplant patients are approximately 85% and 75%, respectively [36]. Immunosuppressive therapy can subject the patient to many systemic complications with serious and even fatal consequences. Local infections that would not be a health threat to an immunocompetent patient may be the source of a fatal septicemia for a transplant patient. The allied healthcare professionals involved in the care of these patients should promote oral and systemic health and optimize a successful convalescence and long-term survival.

DISEASES AND CONDITIONS AFFECTING NEUROMUSCULAR COORDINATION

PARKINSON DISEASE

Parkinson disease is a progressive neurodegenerative condition that affects more than 1 million Americans [37]. The mean age at diagnosis is 60 years. In these patients, the neurons in the substantia nigra of the brain that store and release the neurotransmitter dopamine undergo a 60% to 70% depletion. The result is impaired motor function and poorly coordinated bodily movements [38]. The extent of impairment may be staged/measured using the Hoehn and Yahr scale, which describes five stages of Parkinson disease. The categories range from stage 1, which indicates mild tremors and minimal, unilateral functional impairment, to stage 5, which is characterized by incapacitating motor symptoms that require restriction to bed or dependence upon a wheelchair for ambulation [39]. However, this staging system has been criticized for its over-reliance on physical (rather than psychologic or behavioral) symptoms. The interference with normal motor function can have varied orofacial manifestations that progressively detract from optimal oral function.

Approximately half of patients with Parkinson disease have chronic problems with drooling [40]. Parkinson disease can affect the pharyngeal muscles and those of the tongue and the floor of the mouth, causing dysphagia (difficulty in swallowing). This condition combined with the head flexed in an anterior plane can make swallowing saliva difficult and drooling a chronic problem.

EVIDENCE-BASED PRACTICE RECOMMENDATION

The National Institute for Health and Care Excellence recommends that pharmacologic management for drooling of saliva in people with Parkinson disease should only be considered if nonpharmacologic management (e.g., speech and language therapy) is not available or has not been effective.

(https://www.nice.org.uk/guidance/ng71. Last accessed April 21, 2022.)

Level of Evidence: Expert Opinion/Consensus Statement

Saliva laden with the oral fungal organism *C. albicans* can inoculate the corners of the lips to cause angular cheilitis. This localized fungal infection can cause the lips and adjacent skin to remain cracked and inflamed for extended periods of time with subsequent pain during basic movements of the tissues. Antifungal preparations such as nystatin ointment may provide temporary relief, but angular cheilitis usually recurs in patients with Parkinson disease because its origin, chronic drooling, remains.

The progressive neurodegeneration and commensurate loss of motor skills can make wearing dentures very difficult. The maxillary denture can develop retention problems when the musculature of the soft palate, upon whose termination an adequate suction seal is dependent, undergoes tremors and spasms that destabilize the area. The mandibular denture can present as more of a challenge to the patient with Parkinson disease when the musculature of the tongue, lips, cheeks, and floor of the mouth cannot operate in unison as balancing forces. Zinc-free denture adhesives may offer some additional retention but are not able to totally counter the progressive loss of motor skills necessary for successful prosthetic function. The placement of implants for additional denture retention may be an option in the early stage of the disease. The increasing morbidity associated with advancing Parkinson disease precludes their placement dur-

ing later stages. Patients who possess all or some of their teeth will face oral hygiene challenges as the disease advances and swallowing a bolus of food becomes more challenging. The cumulative effect of the extended contact time between the teeth and the food increases the risk of caries development. Tremors to the fingers decrease patients' ability to maintain optimal oral hygiene and increase the incidence of both caries and periodontal disease. An increasing frequency of recall appointments may be necessary to monitor the degree of oral hygiene impairment and implement strategies for improvement. Caregiver involvement for basic oral hygiene procedures such as brushing and flossing is usually required as the disease progresses.

Pharmacologic management of Parkinson disease includes medications that replace the depleted dopamine, potentiate the action of dopamine that is produced, or increase dopamine availability as it crosses the blood-brain barrier. The medication levodopa is transformed into dopamine by the neurons of the substantia nigra. The benefit of this medication can decrease after prolonged administration, so its use is reserved for adjunctive treatment as the disease advances. A side effect of this medication is orthostatic hypotension; after dental treatment, patients should be raised incrementally from the reclined position to an upright position to minimize the chances of postprocedural syncope. Assistance to and from the chair may be necessary. Entacapone and carbidopa are utilized for patients with Parkinson disease to increase the bioavailability of levodopa, and both can also cause orthostatic hypotension. Selegiline is also prescribed with levodopa. Because selegiline is metabolized in the liver into l-methamphetamine and l-amphetamine, its combination with other sympathomimetic substances, such as epinephrine or levonordefrin, could cause an increase in blood pressure [41]. The patient's blood pressure should be recorded before any procedure, and vasoconstrictors should be used sparingly or avoided completely.

Treatment and Prognosis

Parkinson disease is incurable, and its progression can vary considerably among patients. The illness generally progresses to complete disability and contributes to the death of affected patients despite long-term pharmacologic intervention. Preventive and interceptive dental treatment should be initiated as early as is possible for patients with Parkinson disease. Advancing disease can preclude the ability of the patient to cooperate for basic dental treatment. Cognitive impairment in the latter stages of the disease can require that consent for dental procedures be obtained from a designated representative.

CEREBRAL PALSY

United Cerebral Palsy estimates that 764,000 individuals in the United States have cerebral palsy [42]. In 2006, the International Workshop on the Definition and Classification of Cerebral Palsy updated its definition of the condition, which is recognized as a group of activity-limiting disorders affecting the development of movement and posture [43]. Nonprogressive disturbances that occur in the developing fetal or infant brain cause motor disorders; these can be accompanied by disorders that impair sensation, cognition, behavior, and communication [43]. Cerebral palsy is not associated with specific oral or maxillofacial lesions or abnormalities. However, several oral conditions occur within this patient population.

Periodontal disease is common in patients with cerebral palsy. The motor skills required for brushing and flossing are compromised to varying degrees, especially if cognitive and sensation disturbances accompany the motor problems, and optimal oral hygiene can be difficult to achieve and maintain. Caregivers may not be able to brush and floss the patient's teeth to a degree that allows for effective and consistent removal of bacterial plaque; the cumulative accretion of plaque may lead to gingivitis and ultimately periodontal disease. Some patients with cerebral palsy take medications to control seizures, such as phenytoin. Gingival hyperplasia has been identified as a side effect of this medication and may be exacerbated by plaque accumulation.

When the surfaces of the teeth are covered by more gingival tissue, the ability to maintain plaque control becomes even more of a challenge. A gingivectomy can remove the hyperplastic tissue but recurrence with the continued use of phenytoin remains an issue.

Dental caries are more prevalent among patients with cerebral palsy as a result of the same factors that predispose patients to periodontal problems. Bacteria within accumulated plaque maintain prolonged contact with tooth surfaces and induce the development of dental caries. When the muscles of mastication and swallowing are compromised by cerebral palsy, the teeth have a prolonged exposure time to the bolus of food. This can result in an increased risk for caries. This problem is amplified when it is coupled with a patient's inability to maintain optimal oral hygiene. The irregular surfaces of unrestored carious lesions favor further accumulation of plaque and debris that perpetuate dental caries and periodontal issues.

An estimated 59% to 92% of patients with cerebral palsy have malocclusions, many of which are categorized as Angle's Class II ("buck teeth") classification [44]. Malocclusions decrease the efficiency of mastication and complicate oral hygiene, both of which can increase the risk of periodontal problems and caries. Further, protrusive teeth are more subject to traumatic dental injuries that require expensive endodontic and restorative procedures or extractions. Cerebral palsy is not an absolute contraindication to orthodontic correction for the varied malocclusions. However, an already challenging oral hygiene regimen will become even more difficult.

Dental Treatment Considerations

Dental treatment considerations for patients with cerebral palsy begin with a preventive approach early in the disease process. These patients can have considerable variation in motor and cognitive skills, which will influence maintenance of optimal oral hygiene. Patients for whom adequate brushing and flossing is a challenge must rely on a caregiver to provide adjunctive or complete oral hygiene care. Demonstrations of the appropriate methods of oral hygiene unique to the patient should be demonstrated to the caregiver in the dental office.

Special care must be used in brushing and flossing for these patients as variability in the control of oromotor function can complicate basic oral hygiene procedures. Expectoration of toothpaste and mouth rinses may be difficult for some patients, and the ingestion of excessive amounts of fluoride is a consideration. Only a small amount of toothpaste should be used and only for one quadrant at a time. If mouth rinses are used as an adjunct for oral care, they should be alcohol free.

The frequency of prophylaxis appointments will be determined by the ability of the patient or caregiver to maintain adequate plaque control. Each appointment should include an examination for caries whose prompt restoration is essential for good long-term oral health. Some patients may have muscle spasms and uncontrolled movements that can compromise the ability to provide dental care. These patients will require sedation and may need treatment at an outpatient hospital center.

Treatment and Prognosis

The treatment and prognosis of cerebral palsy is as variable as the patients afflicted with the disease. There is no cure, but advances in medicine and physical therapy techniques have improved the quality of life for many patients. Professionals must strive to provide adequate access to care, including dental care, for patients with cerebral palsy.

SPINAL CORD INJURIES

In the United States, there are approximately 17,810 new spinal cord injuries each year [45]. The extent of sensory and motor function impairment these patients experience will depend upon the level at which the spinal cord was injured. The more superior the location of the injury, the greater the motor and sensory deficit. Because these injuries are usually the result of sudden, traumatic accidents, the oral health status and needs of the patients will span a considerable spectrum. Patients with higher level spinal cord injuries who are quadriplegic will be dependent upon caregiver assistance for all of their oral health needs. Lower spinal cord injuries causing paraplegia allow patients to use their arms and hands; these patients are often able to maintain oral health independently. As noted, any specific dental considerations for patients with spinal cord injury relate to the level of injuries, the degree of presenting periodontal and carious involvement, and ability to provide adequate long-term maintenance of the teeth and soft tissues.

The patient's physician should be consulted before any dental treatment is begun. Quadriplegic patients may have difficulty with adequate ventilation as well as an impaired gag and cough reflex and problems with the control of oral fluids that can accumulate during dental procedures [46]. Paraplegics usually do not have these difficulties but will require assistance upon transfer from the wheelchair to the dental chair. An accompanying caregiver may assist with the transfer in a manner that will not cause injury to the patient. Dental team members who wish to assist with chair transfers should obtain the proper training.

The sustained pressure on weight-bearing areas common among individuals who use wheelchairs or who are bedridden can cause localized ischemia and the development of decubitus (pressure) ulcers of the skin. If longer appointments are required, a change of the position of the legs can decrease the occurrence of this problem. If they develop, skin ulcerations of this nature can become infected locally and provide a portal of systemic dissemination for pathogenic organisms, potentially resulting in sepsis. Quadriplegic patients may require some of their dental or oral care treatment in a hospital setting.

There is an increased risk of aspirating solids or liquids into the lungs with quadriplegia, and aspiration pneumonia is a possibility [47]. The rapid removal of water from high speed handpieces used for restorative dentistry or during hygiene procedures is mandatory to prevent the aspiration of accumulated fluids. Rubber dam isolation of the area to be treated may not be possible for quadriplegic patients with ventilation issues. Complex treatment for these patients can require a concerted effort of the general dentist and dental specialists. Both quadriplegic and paraplegic patients may have anticoagulants such as warfarin, dipyridamole, or aspirin prescribed to reduce the chance of thrombosis. Procedures in which hemostasis is a concern, including oral surgery, periodontal surgery, and root planing and curettage, should not be undertaken without physician consultation.

Quadriplegic patients who wear dentures or partial dentures will require a caregiver to insert, remove, and clean these prostheses. Some partial dentures can be difficult to insert or remove, so caregivers should receive education regarding appropriate placement and removal techniques. Partial dentures placed or removed with excessive force can traumatize the teeth and oral mucosa and damage the partial denture clasps and framework. Partial and complete dentures must be relined or remade periodically in response to changes of the alveolar bone and overlying oral mucosa. Prostheses that conform to the oral tissues and provide the appropriate occlusion will be an essential component in the oral and overall health of these patients.

Treatment and Prognosis

Today, there is no cure for spinal cord injuries. Those who provide home care for quadriplegic patients must be able to provide adequate oral care on a daily basis. Periodic dental examinations and prophylaxis procedures are also necessary. During dental examinations, the oral health status of patients with spinal cord injuries may be monitored and interventional treatment provided as required.

STROKE

The American Heart Association estimates that every 40 seconds someone in the United States has a stroke [48]. As such, stroke is the fifth leading cause of death in the United States, after heart disease, cancer, accidents, and chronic lower respiratory diseases [49]. Strokes are the result of interruption of the blood supply to the brain via ischemic or hemorrhagic means. Ischemic strokes are more common and develop from the thrombosis of a cerebral vessel or from a distant embolus that has become lodged in a cerebral vessel. Hemorrhagic strokes involve bleeding within the brain; this type of stroke accounts for approximately 12% to 18% of all stroke cases [48; 71].

The residual motor and sensory deficits associated with a stroke will depend upon the area of the brain in which the affected cerebral vessel was located. Strokes that involve the patient's dominant side can reduce the neuromuscular coordination that is essential for proper oral hygiene techniques. The hand of the unaffected, non-dominant side can be used in attempt to brush the teeth, and a flosser may be used to floss with only one hand. Physical therapy can help, but not all patients will regain use of the affected side. Stroke patients will depend upon healthcare professionals, while hospitalized, or home caregivers to provide basic oral hygiene procedures. Some stroke patients may require this assistance for the remainder of their lives. Because the oral hygiene of these patients can undergo demise after a stroke, it is essential that periodic dental examinations and prophylaxis appointments be maintained. Oral care should be deferred until the patient is stabilized and elective surgical procedures should be deferred for at least six months after the occurrence of a stroke [9]. The patient's physician should be consulted before any treatment is initiated.

Underlying conditions such as diabetes, hypertension, and cardiovascular disease may have been instrumental in causing the stroke. Medications prescribed for these and other chronic conditions may affect the selection of local anesthetics, analgesics, and antibiotics that are used for dental treatment. In addition, anticoagulant medications such as warfarin, clopidogrel, or aspirin are usually prescribed to decrease the chance of another stroke. Anticoagulants' intended effects can be potentiated with the coadministration of many medications used in dentistry, including NSAIDs (e.g., ibuprofen, naproxen), penicillin, and amoxicillin [50]. Patients on anticoagulant therapy should not have any invasive procedure without collaboration with their physician. A temporary hold on anticoagulants may be necessary unless the risk of another stroke or other cardiovascular event precludes the temporary discontinuance. Patients should never discontinue anticoagulant therapy unless it is under the guidance of a physician. If use of anticoagulants must be continued, laboratory values such as INR and PT can provide the clinician with necessary information regarding the patient's ability to achieve hemostasis. Further considerations for patients on anticoagulant therapy will be discussed later in this course.

Dental Treatment Considerations

Dental treatment considerations vary considerably among stroke survivors according to the initial amount of cerebral damage and the level of long-term disability. Even patients for whom minimal damage has occurred and who appear to have minimal motor and sensory deficits should not undergo dental treatment until physician approval has been granted. Unfortunately, many stroke victims do retain long-term or permanent sensory, motor, and cognitive problems that impact oral health and function and the ability to undergo dental treatment.

Dysphagia can occur when strokes cause neural and muscular compromise to the floor of the mouth, the tongue, and the pharynx. Eating and drinking can become a challenge with this condition, and patients may select foods of softer consistency that facilitate swallowing but compromise proper nutrition. The same neural and muscular issues can make partial dentures difficult to wear and the use of complete dentures nearly impossible. Partial dentures are retained by teeth and only partially reliant upon a balance of muscular forces for their retention. A complete maxillary (upper) denture depends upon a functioning musculature, especially at the junction of the hard and soft palates, for its retention. A complete mandibular (lower) denture relies on a balance between the muscles of the cheeks, tongue, chin, and floor of the mouth for retention. When stroke-related involvement of one or more of these muscles occurs, the stability and retention of prostheses are compromised. Patients may also feel that it is difficult to re-establish the proper occlusal pattern needed for proper mastication. The use of implant-retained dentures or denture adhesives (zinc-free) may be of assistance. However, surgery for implant placement should only be done with physician approval.

Cognitive impairment may remain for the patient's lifetime. Matters related to treatment options and informed consent may be beyond the comprehension of some post-stroke patients and will be delegated to their legally appointed representative.

Because many stroke patients are also being treated for hypertension, the use of vasoconstrictors, such as epinephrine and levonordefrin, which are combined with most local anesthetics, should be kept to an absolute minimum or avoided. Appointments should be kept short and as stress-free as possible, with vital signs monitored throughout. Patients should be kept in a position that accommodates unilateral weakness or paralysis and protects them from the accumulation of fluids and debris in the mouth. Many stroke patients develop dysarthria, a condition in which the muscles used for proper speaking are weakened, resulting in slurred speech. Clinicians will need to spend more time to communicate effectively with patients when this occurs.

Approximately 30% of stroke survivors have depression [51; 71]. This can decrease patients' desire for recovery and can result in an overall decline in oral hygiene. Some antidepressants used in the treatment of depression can cause xerostomia. As discussed, xerostomia decreases the cleansing action of saliva and increases the retention of plaque on teeth and within the gingival sulcus, resulting in an increased risk of caries and periodontal problems. Tricyclic antidepressants such as amitriptyline can potentiate the vasopressor effects of both epinephrine and levonordefrin [51]. The concurrent use of these agents can raise the blood pressure to levels that endanger stroke survivors, and their use should be avoided.

Treatment and Prognosis

Treatment and prognosis vary among stroke survivors. The underlying medical condition(s) that precipitated the stroke require continuing treatment to decrease the risk of recurrence of stroke. Patients should be evaluated on an individual basis to determine their ability to maintain adequate oral hygiene and optimal oral health. Careful attention to the medical issues that confront stroke patients will allow necessary dental treatment to be accomplished in a safe manner.

Considerations for Patients on Anticoagulant Therapy

Many stroke patients are initiated on anticoagulant therapy as a secondary prevention measure. Anticoagulant medications influence the synthesis of clotting factors. Antiplatelet therapy is used to decrease the risk of adverse cardiovascular events in patients with arterial or venous thrombosis, ischemic heart disease, coronary artery stents, or a history of an ischemic cerebrovascular accident [52]. Aspirin and clopidogrel, used individually or in combination, are among the most common of these agents. Aspirin inhibits the formation of thromboxane A2, a platelet product necessary for platelet adhesion. This inhibitory effect lasts for the 7- to 10-day lifespan of the platelet; the production of new platelets overcomes

the inhibitory effects [53]. Clopidogrel inhibits the activation of platelets and ultimately the fibrinogen binding that is required for platelet adhesion.

Among the coumarin derivative class of anticoagulant medications, warfarin is the most commonly prescribed. Warfarin inhibits the synthesis of Factors VII, IX, and X and prothrombin, all of which are vitamin K-dependent coagulation proteins. The efficacy of warfarin therapy is monitored using the INR, the values of which reflect the therapeutic range of anticoagulant therapy. This ratio is determined by dividing the PT of the patient by the mean normal PT of the laboratory. The latter is determined by using the International Sensitivity Index [54]. A value of 1.0 reflects normal PT, while higher values indicate an extended PT. The goals of anticoagulant therapy are determined by the nature and extent of the medical problem involved. Prescribed and over-the-counter medications used in the treatment of oral conditions must not potentiate the intended therapeutic range of anticoagulant therapy, as internal bleeding can result. When procedures such as periodontal surgery or root planing and curettage are planned, verifying the patient's ability to attain and maintain hemostasis is essential. When extensive treatment such as multiple or full-mouth extractions is planned, postoperative bleeding can be significant and the procedure may need to be performed in a hospital setting. Patients who use either clopidogrel or aspirin for antiplatelet therapy have a lower risk of postoperative bleeding compared to those on combination therapy. As discussed, patients must be advised never to discontinue their anticoagulant or antiplatelet therapy unless it is approved by their physician.

NSAIDs, some antibiotics, and certain antifungal medications can increase the risk of postoperative bleeding when they are combined with anticoagulant or antiplatelet medications. Whenever possible, alternative medications should be utilized. The duration of anticoagulant and antiplatelet therapy is usually for the lifetime of the patient. Dental clinicians must be cognizant of the patient's current regimen and note any difficulties in internal or occult bleeding that would indicate potential problems in the achievement of postoperative hemostasis. Recent INR value and PT and consultation with the patient's physician can provide guidance for the course of dental treatment that is the safest for the patient.

CONDITIONS CAUSING COGNITIVE IMPAIRMENT

DOWN SYNDROME

Down syndrome is a genetic disorder resulting from an aberration of the 21st autosomal chromosome. Nearly 95% of those affected have a complete extra chromosome (trisomy 21) while the remaining 5% have other chromosomal abnormalities (mosaic trisomy 21) [55]. In the United States, more than 400,000 individuals are living with Down syndrome [56]. The development of mental and physical features progresses more slowly for individuals with Down syndrome compared to those without it. The development of motor and language skills is delayed, and the degree to which they are ultimately impaired varies considerably among these individuals, as does intellectual capacity. Most patients with Down syndrome have some degree of intellectual disability that will challenge their cognitive development. Common anomalies and trends in the oral and maxillofacial region can challenge the ability of patients with Down syndrome to maintain optimal oral health.

The presence of an underdeveloped maxillary arch is typical among patients with Down syndrome. This coupled with a mandibular arch of normal dimensions establishes a Class III jaw relationship (mandibular prognathism or underbite) [57]. Abnormal morphology of the teeth, such as shorter and smaller clinical crowns, coupled with a Class III malocclusion can cause compromised occlusal function and difficulties with the proper mastication of food. The

delayed eruption sequence of teeth and a higher incidence of congenitally missing teeth among these patients can further prevent the development of a stable occlusion [58]. The occurrence and severity of periodontal disease are both more prevalent among individuals with Down syndrome. The aforementioned problems with congenitally missing or late erupting teeth can cause teeth to drift and incline in a fashion that does not facilitate optimal oral hygiene. Deficiencies in the immune system among these individuals will diminish the response against pathogenic bacteria. Leukocytes such as granulocytes and lymphocytes are the primary cells involved with defense against bacterial infections [59; 60]. Nearly half of patients with Down syndrome have chemotactic defects in their neutrophils that prevent the proper migration of these leukocytes towards the pathogenic bacteria [61]. The function of T-lymphocytes is also compromised among many patients with Down syndrome. A combination of decreases in both mitotic activity and the response to an antigenic challenge and an increase in the production of immature T-lymphocytes diminishes the appropriate immune response to periodontal pathogens [62].

When loss of alveolar bone results from this combination of factors, patients with Down syndrome are at a greater risk of tooth loss due to root anatomy variances. Shorter roots and the fusion of molar roots that are usually separate and divergent mean these teeth have less attached alveolar bone at the onset [63]. Therefore, bone loss that would not threaten the retention of teeth in patients without Down syndrome may cause advanced mobility and a poor prognosis for retention among this patient population. The ability for patients with Down syndrome to brush and floss properly will be commensurate with the degree to which their motor skills and cognitive ability have developed. Given these circumstances it is imperative that oral home care and recall appointments combine to create as healthy an oral environment as possible. It may be necessary for caretakers to assist in basic hygiene techniques.

The prevalence of dental caries varies among patients with Down syndrome. The delayed eruption of both the deciduous and permanent dentition common among patients with this disorder decreases the time of exposure to cariogenic bacteria. Clinical crowns that are smaller than average can create spaces between the teeth and can actually facilitate their cleansing. Smaller nasal passages and increased tonsillar volume can cause congestion of the upper respiratory tract. Open-mouthed breathing is a compensatory mechanism for this problem [64]. This breathing pattern has a drying effect on dental plaque and can increase the incidence of both dental caries and periodontal disease. If this pattern is noted, increased frequency of brushing and flossing combined with shorter intervals between dental recall appointments must be enacted.

Treatment and Prognosis

Medical advances have increased the life expectancy of patients with Down syndrome. While these patients have a higher tendency for diverse medical problems, including cardiac issues and seizure disorders, many live past 55 years of age and some outlive their parents. Arrangements for a succeeding caretaker may involve another family member, or in some cases, institutionalization. In either case, access to dental care should remain a steadfast commitment. Most patients with Down syndrome can be treated by a general dentist in a traditional office setting. Patients with moderate-to-severe intellectual disability may require sedation in office or at an outpatient hospital setting. Consistent recall appointments and evaluation of the patient's daily oral hygiene regimen are both proactive practices that can positively impact oral health and quality of life.

ALZHEIMER DISEASE

Approximately 6.5 million people in the United States are living with Alzheimer disease, a major cause of dementia [65]. Alzheimer-type dementia occurs in 32% of Americans older than 65 to 84 years of age and in 36% of patients 85 years of age or older [66]. Alzheimer disease is the most common

form of dementia and is responsible for 60% to 80% of all new dementia cases [67]. It is a slowly progressing disease that causes memory loss, cognitive impairment, changes in personality, and ultimately, functional impairment and inability to carry out activities of daily living. The initial stage features minimal cognitive impairment and memory loss. Progression to the middle stage features language impairment and the loss of abstract reasoning skills. These problems along with delusions, paranoia, and marked personality changes are seen in the late stage of the disease. Patients in the end-stage of Alzheimer disease become rigid, incontinent, and bedridden. These patients usually succumb to cardiac problems, pulmonary embolisms, or opportunistic infections (e.g., aspiration pneumonia) [68].

Dental Treatment Considerations

There are no oral lesions that are unique to Alzheimer disease. The dental considerations for these patients involve proactive and preventive care in the early stages of the disease while patients are most cooperative and are able to provide a reasonable level of basic oral hygiene by themselves. The ability of the patient to cooperate during dental treatment will decrease during the later stages of this disease. Thus, addressing dental problems as soon as possible after a diagnosis of Alzheimer disease has been confirmed as essential.

The interaction of medications prescribed for Alzheimer disease and systemic illnesses with those utilized for dental treatment are an additional concern. Patients with Alzheimer disease for whom periodontal problems have been controlled and carious lesions have been restored will require recall appointments, the frequency of which is determined by the patient's or caregiver's ability to maintain adequate home care. As this disease progresses, patients may forget to brush and floss their teeth on a regular basis (or forget what a toothbrush is) and may not be cooperative when a caregiver attempts to provide this service. This can potentiate existing periodontal problems or cause new problems to develop. Similarly, new and recurrent carious lesions can develop when the ability to maintain oral hygiene declines.

Because cognitive ability can vary considerably among patients with Alzheimer disease, even in the initial stages, it may be necessary to obtain consent for treatment from an accompanying caregiver or family member. Some patients with Alzheimer disease will not seek routine dental care, and advanced periodontal problems and multiple carious lesions can develop. An attempt to resolve these periodontal issues and to restore the carious lesions is the ideal treatment plan. However, maintenance of these teeth will become more difficult as the disease progresses. The patient, caregiver, and allied healthcare team must discuss optimal treatment options. Patients who did not practice good oral care prior to the diagnosis of Alzheimer disease are unlikely to improve these skills. Extractions of periodontally involved teeth and those with extensive carious lesions can be a practical option for these patients. As the patient's ability to cooperate during dental treatments declines, procedures that require longer appointments and are more complex must be done as early in the disease progression as possible. If partial or complete dentures are made, the patient's name should be incorporated into the acrylic of each prosthesis. This identifying feature will facilitate the return to the appropriate patient if the prosthesis is misplaced. Partial dentures should have a simplified design to facilitate their insertion and removal, and caregivers should be taught these techniques and appropriate home care.

Treatment and Prognosis

Depletion of the cerebral neurotransmitter acetylcholine is a contributing factor in the development of Alzheimer disease, and medications such as donepezil, rivastigmine, galantamine, and memantine are used to reduce the degradation of acetylcholine by the enzyme acetyl cholinesterase [69]. These medications can stimulate the secretion of gastric acid and increase the risk of the development of peptic ulcers [9]. Concurrent use with NSAIDs can increase this risk, so alternative medications compatible with the patient's medical history should be utilized.

Antidepressant and psychotropic medications may also be prescribed for patients with Alzheimer disease. Narcotic analgesics and sedatives can potentiate the effects of these medications and may need to be avoided. Medications for concurrent chronic disease(s) can also influence the selection of analgesics, antibiotics, local anesthetics, and sedatives used for dental problems and treatment. A consultation with the patient's physician should be completed prior to the initiation of dental treatment and updated as the disease progresses. The late and end stages of the disease may require that necessary dental care is performed via sedation or under general anesthesia in a hospital setting. Maintaining the oral comfort and dignity of the patient should be the primary goal of dental treatment.

CONCLUSION

This course has highlighted a diverse group of acquired and congenital diseases and syndromes that can significantly impact the lives of patients. All diseases and syndromes discussed are incurable and will impact the patient's and/or caretaker's ability to maintain optimal oral hygiene and the clinician's ability to provide dental treatment. Similarly, medications used to treat these conditions may interact with medications involved in dental or oral care; the use of alternative medications may be necessary. Although each of the diseases/conditions has been discussed singularly, many patients have concurrent illnesses that synergistically complicate their oral and overall health. Furthermore, the aging process can increase the morbidity associated with these diseases.

Dental treatment should be an integral part of the overall health care of any patient with disability. Early preventive treatment can minimize the potential for the development of carious lesions and periodontal problems. Frequent recall appointments reflecting each patient's ability to maintain ideal oral hygiene will also serve to identify new carious lesions and emerging periodontal problems. When these issues are discovered in their initial phases, treatment is less complicated and less expensive compared to treatment attempted when the issues are advanced. Patients with cognitive impairment and neuromuscular degeneration may have difficulty withstanding longer appointments that are required for complex dental treatment. Thus, early identification of dental problems and a proactive approach for their treatment is in the best interest of all. Meticulous attention to the details of a patient's medical problem(s) and prescribed medications allows oral home care and dental treatment to be performed in a unified approach that promotes ideal oral health as a part of an optimum quality of life.

Implicit Bias in Health Care

The role of implicit biases on healthcare outcomes has become a concern, as there is some evidence that implicit biases contribute to health disparities, professionals' attitudes toward and interactions with patients, quality of care, diagnoses, and treatment decisions. This may produce differences in help-seeking, diagnoses, and ultimately treatments and interventions. Implicit biases may also unwittingly produce professional behaviors, attitudes, and interactions that reduce patients' trust and comfort with their provider, leading to earlier termination of visits and/or reduced adherence and follow-up. Disadvantaged groups are marginalized in the healthcare system and vulnerable on multiple levels; health professionals' implicit biases can further exacerbate these existing disadvantages.

Interventions or strategies designed to reduce implicit bias may be categorized as change-based or control-based. Change-based interventions focus on reducing or changing cognitive associations underlying implicit biases. These interventions might include challenging stereotypes. Conversely, control-based interventions involve reducing the effects of the implicit bias on the individual's behaviors. These strategies include increasing awareness of biased thoughts and responses. The two types of interventions are not mutually exclusive and may be used synergistically.

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