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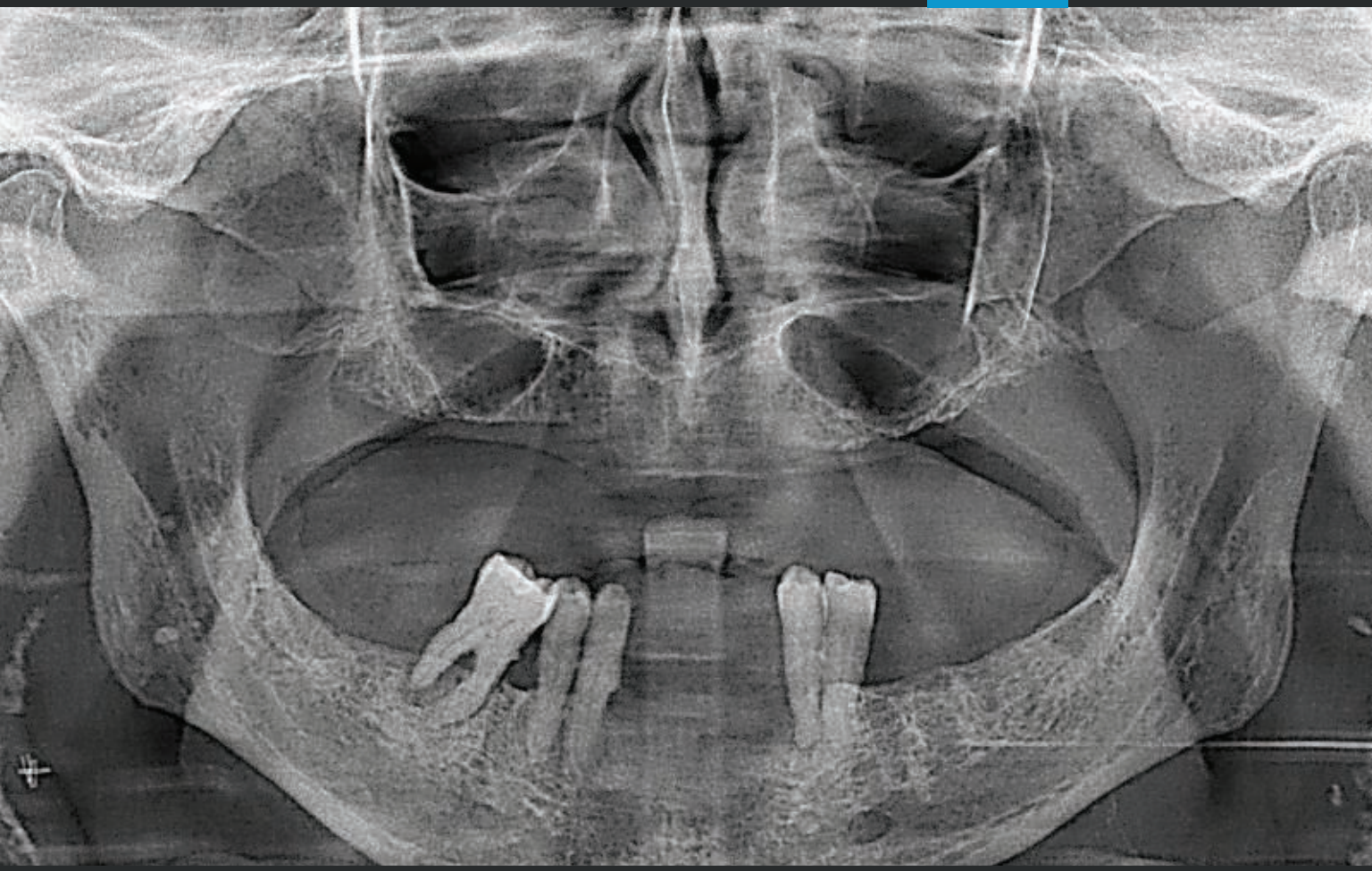

Carotid stenosis and the dental patient: An overview for the dental hygienist

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Abstract

To provide the patient with the best possible outcomes, it is crucial that the dental hygienist be able to detect carotid stenosis on a panoramic radiograph. Understanding the pathology behind carotid stenosis, as well as identifying risk factors, assists the dental hygienist with this detection. To optimize care, the dental hygienist must also be able to instruct patients on the importance of follow-up care with their primary health-care provider in a timely manner. It is also important that the dental hygienist is able to provide referral information to the patient who does not have a primary health-care provider.

Educational objectives

Upon completion of this course, the dental hygienist should be able to:

- Locate physical landmarks associated with carotid stenosis
- Identify pathology associated with carotid stenosis
- List risk factors associated with carotid stenosis
- Discuss the role of the hygienist in detecting blockage visible on a panoramic radiograph
- Instruct patients on the importance of timely follow-up care with their primary health-care provider
- Facilitate a referral if the patient does not have a primary health-care provider established

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Introduction

Patient outcomes depend upon the correct and timely assessments and interventions of health-care professionals. Regardless of health-care profession, it is crucial to patient health that those individuals responsible for some aspect of patient care function independently at the maximum level of skill development. For the dental hygienist, this means the ability to provide more than dental care. It includes the ability to detect anomalies identified via panoramic radiograph. This skill, acquired in training, is enhanced and further developed in the practice setting.

It is crucial that the dental hygienist demonstrates the ability to detect carotid stenosis, a pathology that can lead to blockages. Stenosis, or narrowing of the diameter of the artery—and eventual blockage if left untreated—can result in loss of oxygenation to the brain, face, and neck. There are known predisposing factors related to stenosis/blockage. Working with the primary health-care provider, the individual can decrease risk for stenosis and therefore blockages. However, in order to minimize these predisposing factors, it is essential that patients have an effective and trusting relationship with their primary care provider, as they have to truthfully discuss lifestyle choices and develop strategies to minimize harmful effects and maximize healthy lifestyle choices.

Ultrasonography has become the tool of choice for diagnosing carotid artery stenosis due to its reliability and accessibility. However, ultrasound investigations are not routinely carried out as preventive measures in all patients.[1] Other means do exist, including cone-beam computed tomography angiography (CBCT-CA) and panoramic radiography.[2,3] Panoramic radiographs are low cost, less invasive, and technically simplistic. They are routinely used for diagnosis for teeth and the jaw, but also have a diagnostic function in identifying lesions present in the adjacent structures of the face and neck, specifically the carotid artery. On a panoramic radiograph, blockages appear as radiopaque images extending to the ramus and angle of the mandible to the base of the neck. These incidental findings can identify subpopulations with increased risk.

Pathophysiology

Carotid blockage is most commonly observed in individuals with carotid stenosis, or narrowing of the carotids, caused by pathologies of cerebrovascular disease. Located bilaterally in the neck, these arteries are responsible for the oxygenation of not only the brain, but also the face and neck.[4] Several etiologies impact the development of carotid stenosis, with the predominant cause linked to a buildup of plaque or calcification on the walls within the arteries (i.e., atherosclerosis).

Histology

Plaque deposits associated with atherosclerosis can be a fatty streak, a fibrous atheromatous plaque, or a complicated lesion.[5] Regardless of histology, the plaque deposits on the arterial wall not only narrow the diameter of the vessel, increasing the pressure needed to force blood through the passage, but may produce a surface more susceptible to the attraction of thrombi or potential to become hemorrhagic.[6] Confirmation of histology is dependent upon plaque examination; thus, removal is necessary.[7]

Prevalence

When the individual is asymptomatic and thus unaware of having the stenosis, he or she gives an impression of wellness, when in fact, the individual is at risk of complications associated with the pathology. In the United States, stroke, a manifestation of carotid artery stenosis, is the third major cause of death among adults.[8] Research indicates that moderate stenosis is more likely to occur in men, with that likelihood increasing with age. For males over the age of 70, there is approximately 10% likelihood of the individual having moderate asymptomatic carotid artery stenosis.[8]

Risk factors

Risk factors associated with these plaque deposits include both modifiable and nonmodifiable factors. Nonmodifiable risk factors include advanced age, gender, and genetic predisposition. Since these risk factors are not able to be influenced, the best intervention is for the individual to focus on healthy lifestyle management by examining the modifiable risk factors. Modifiable risk factors include the use of nicotine, high cholesterol diet, hypertension, diabetes, hyperlipidemia, stress, and a sedentary lifestyle.[9]

Nicotine use, specifically via cigarette smoking, significantly decreases cerebral blood flow.[10] Therefore, the individual who regularly smokes cigarettes can potentiate decreased blood flow through a stenosed carotid artery, causing the brain, face, and neck to be deprived of oxygenated blood. Working with a trusted primary health-care provider, the individual can explore effective smoking cessation options. After 15 years of smoking cessation, the impact of prior smoking decreases this modifiable risk factor to the equivalent of that of a nonsmoker.[11]

A high cholesterol diet and subsequent hyperlipidemia are linked with cardiovascular disease, which impacts the integrity of the carotid arteries. Focusing on a diet robust with vegetables, fruits, whole grains, and poultry/fish while limiting food high in saturated fats can impact the individual's LDL cholesterol level.[12] When diet modifications alone are not effective in reducing blood cholesterol levels, the primary health-care provider may suggest medications, such as statins.[13] Because of the difference in metabolizing these medications in the female vs. male body, it is essential that the individual interacts well with their primary care physician.

Hypertension and diabetes also pose physical threats to the body. Hypertension is defined as having a systolic blood pressure ≥ 140 mm Hg or a diastolic blood pressure ≥ 90 mm Hg as an average of three separate readings.[14] When the individual experiences hypertension, artery diameter is smaller or constricted. This narrowing causes the heart to work harder in order to push the blood through the circulatory system. The ability to lower blood pressure to ≤ 126 mm Hg systolic and/or ≤ 80 mm Hg diastolic can decrease the negative impact associated with cardiovascular disease. Because of the strong correlation between diabetes and cardiovascular disease, the diabetic individual must work closely with the primary care physician to optimize health by controlling blood glucose levels regularly.[15]

Acute psychological stress is believed to increase plasma fibrinogen levels.[16] With these levels increased, the individual is at

a higher risk of experiencing vessel occlusion.[17] For individuals with carotid stenosis, acute stress can increase the chance of carotid blockage, thus effectively decreasing oxygenation to the brain, face, and neck. It is essential that individuals discover and develop effective stress-coping methods. The primary health-care provider can provide strategies as well as referrals to alternative options for stress management.

An increasingly sedentary lifestyle, which is connected to obesity, impacts cardiovascular disease. Having honest, productive conversations with the primary health-care provider can help the individual to identify factors influencing this lifestyle and subsequent obesity, while taking an active role in changing to a more physically active lifestyle.[18] There are many options for increasing physical activity, with walking providing one of the easiest and most economical ways to begin changing personal activity habits.

Panoramic radiographs and carotid artery calcifications

Two-dimensional projections such as intraoral films examine the entire tooth, while panoramic imaging shows a wide view of the maxilla and mandible and surrounding structures.[19] Cone-beam computed tomography (CBCT)—three-dimensional imaging—has been implemented in dentistry to provide more detailed information and accurate interpretation.[19] When determining which radiographs to expose, the American Dental Association (ADA) recommends dentists use their own discretion by knowing the patient's health history and vulnerability to oral disease.[20] With this information, the ADA recommendations are merely that and do not serve as a generalized standard of care. If the patient presents with clinical evidence of generalized oral disease or an extensive history of dental treatment, a full-mouth series (FMX) is recommended.[20] Only posterior bitewings are recommended for recall appointments unless the clinician is monitoring growth and development or assessing dental and skeletal relationships.[20] Those individuals with full or partial dentition are recommended to receive posterior bitewings with a panoramic radiograph or posterior bitewings with selected periapical images.[20] Panoramic radiography should be evaluated for pathology of the teeth and jaw, especially incidental findings in the soft tissue region of the neck.[20,21] For completely edentulous patients, radiographs are based on clinical signs and symptoms.[20]

With the panoramic in mind, osseous structures of the maxillofacial region, soft tissues, air spaces, and the alveolar process and teeth can be viewed.[22] It is imperative to understand panoramic anatomy as superimposed images may create shadows, causing challenges with interpretation.[22] Carotid artery calcifications are one abnormal finding on radiographs. Patients with clinically evident periodontitis display carotid calcifications in panoramic radiographs more frequently than those without periodontitis.[23] These calcifications in the area of the carotid artery can be detected in 2–5% of the population.[24,25] They can present as irregular, nodular masses extending from the region of the ramus and angle of the mandible to the base of the neck.[26] They may also be observed as punctate, vertical lines, or irregular nonhomogeneous radiopacities adjacent to the cervical vertebrae at or below the intervertebral space C3-C4.[25,27] Atheromas, also known as plaque that has accumulated on the interior of the artery, are normally deposited along the common carotid artery that bifurcates, giving rise to the internal and external carotid arteries.[26,28] Most of the atheromas viewed in studies were detected on the left side (80.2%), although further research is needed to determine if there is a tendency for a specific side.[29]

Different radiopacities are in close proximity to the region of findings compatible with carotid calcifications.[25] Differential diagnosis of radiopacities in this area include the greater cornu of the hyoid bone, epiglottis, stylohyoid ligament, submandibular sialolith, phleboliths, cervical arterial calcifications, calcified triticeus cartilage, superior cornu of calcified thyroid cartilage, and calcified lymph nodes.[25,30] These distinctions can be made by using a combination of radiographs and clinical exam.

Case study

A 66-year-old male patient with a history of diabetes, arthritis, high blood pressure, and heart disease was referred to a dental hygiene school from a local office to obtain a panoramic radiograph for extraction of his remaining teeth. His health history gave a narration of heart surgeries during the past 30 years, including a quadruple bypass and, six years later, a triple bypass. He also had two stents placed 15 years later and surgery on his right carotid artery due to 90% blockage, while his left was in worse condition. He took insulin and multiple heart medications daily, as well as received computed tomography scans every six months to monitor the blockage and the changes of an aneurysm in his carotid artery. The patient disclosed that he smoked 10 cigarettes a day and had no interest in quitting. He also suffered from severe periodontal disease, indicating his need for maxillary and mandibular prostheses.

Figure 1: 66-year-old male patient with a history of diabetes, arthritis, high blood pressure, and heart disease, and a 40-year smoking habit. Patient will undergo extraction of remaining teeth due to periodontitis. The panoramic radiograph shows bilateral calcified carotid artery atheromas scattered throughout.

After exposing a panoramic radiograph, radiopacities were observed bilaterally and a referral was given to the patient's cardiologist for further examination (figure 1). The patient followed up with his cardiologist and was recommended to continue with his medications and monitoring the atheromas every six months rather than performing surgery due to being such a high-risk patient for complications.

Association between carotid stenosis and periodontal disease

Periodontal diseases are chronic diseases initiated by microorganisms associated with unresolved inflammation affecting the gum tissue and bone supporting the teeth.[31–33] Approximately one out of every two American adults aged 30 and over has periodontal disease (47.2%), and in those 65 and older, prevalence rates increase to more than 70%.[34] Uncontrolled oral inflammation is now recognized as a major driver of human pathologies, including arthritis, asthma, cancers, cardiovascular diseases, and periodontitis.[32,33] Several possible reasons exist to explain the relationship between cardiovascular disease and periodontal disease. When microorganisms in the dental pockets travel through the bloodstream, bacteremia and systemic inflammation occur.[31,35] The transient bacteremia is common after dental procedures regardless of periodontal status, and after mastication or after oral hygiene care at home.[35] The intensity of bacteremia correlates positively with infection at distant organs, suggesting it is able to establish itself in extraoral locations.

A relationship has been made with two major bacteria associated with periodontal disease, *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis*. Some studies have confirmed this bacteria to be present in atheromatous plaque, although this has not been the case for all studies and further research is needed.[35] It must be recognized there are over 700 species of bacteria in the oral cavity, and it is highly unlikely that the effects of periodontal infections on cardiovascular disease are attributable only to the small number of periodontal pathogens studied thus far.[35]

If patients exhibit both periodontitis (specifically, moderate to severe) and carotid calcifications, they are at a much higher risk of having a myocardial infarction than individuals with only one of the conditions.[23,31] Regardless of the extent of the periodontitis, modifiable and nonmodifiable risk factors also have to be examined.

Implications for the dental hygienist

Dental hygienists are responsible for educating patients, assessing intra- and extraoral findings, providing prevention therapies, and aiding the dentist in diagnosis of anomalies. Multiple methods exist in diagnosis, particularly visual exams and radiographs. Hygienists are often the first clinicians to examine the oral cavity and review patient radiographs. Knowledge of anatomy is critical in identifying abnormalities. Compliance with the American Dental Association (ADA) recommendations is also vital, although individualized cases might not fit their criteria. ADA guidelines do not recommend a panoramic radiograph for patients with a healthy dentition, which allows possible pathologies to go undiagnosed. Only a little over half of the population visits dental offices biannually, typically for hygiene maintenance. Although dental practice acts vary among jurisdictions, individuals may only be required to receive an exam by the dentist once per year, putting more responsibility on the hygienist. The ADA also reports approximately one in five individuals (21.3%) have not visited the dentist in the last few years, increasing the risk of periodontal disease, thus leading to systemic health concerns.[36]

Excellent patient motivation skills are important for health-care-related professions, especially dental hygienists. The regularity with which hygienists see patients and update their medical histories puts them in one of the best positions to detect unidentified health concerns.[37] The association between periodontal infection and systemic diseases makes it critical for early identification, treatment, and management by dental and dental hygiene professionals.[25] Educating patients and the public about the growing body of evidence of the oral-systemic link is needed to maintain overall wellness. One way this can be accomplished is through collaboration with medical professionals.

With dental providers and primary care physicians as the first line of detection and treatment for the public, an open conversation can be established to discuss a variety of concerns affecting the patient's quality of life, general well-being, and potential health risks.[38] Since a great number of patients with undetected and untreated cardiovascular conditions pass through dental offices each day, it is necessary for proper training and identification of these conditions or abnormalities. Attending dental conferences or continuing education courses, listening to podcasts, and networking with local dental offices and hospitals all provide options to enhance knowledge and stay up to date on the latest protocols.

A referral system should be utilized to link the patient to the proper specialist for diagnosis. Initially, the individual should have an ongoing relationship with a primary health-care provider. This relationship is crucial for serving as the gatekeeper to referral doctors, as well as minimizing the effects associated with modifiable risk factors. Patients with primary health-care providers tend to experience consistency in care over time, which significantly impacts adherence to a healthy lifestyle. Upon the referral of the primary care provider, the patient will see a physician specifically trained to diagnose and treat cardiovascular disorders and disease. Depending on the findings of this specialist, an additional member may be added to the health-care team. If intervention is needed via surgery, a cardiovascular surgeon will be utilized. This individual will be responsible for determining the severity of the disorder and determining the best plan of care for the patient.

There are several tools available to the cardiovascular specialist to determine the severity of the stenosis. These include an ultrasound—which measures the blood flow through the arteries—a computed tomography (CT) or magnetic resonance imaging (MRI), both of which provide better visualizations of arterial abnormalities. Depending on the results, the specialist may elect for the more invasive diagnostic test of angiography. This test uses injected dye to clearly depict blood flow through the questionable areas.[39]

Treatment for carotid stenosis varies from regular monitoring with attention to lifestyle changes (e.g., low cholesterol diet, smoking cessation) to the addition of

medication, and most invasively, surgery. Regardless of the type of surgery (angioplasty, stenting, or endarterectomy) the goal is to preserve blood flow through the carotid artery to the brain; failure to do so leads to potentially fatal consequences.[40]

Despite the treatment prescribed, ongoing communication among members of the multidisciplinary medical team is essential for success.[38] Medical and dental home establishments aid in communication of treatment with all team members. Repeated reinforcement of recommendations from the dentist and physician will ensure the patient receives streamlined directions as well as attain the best quality of life. By working together, dentists and physicians can avoid the possible consequences of carotid stenosis, improving the overall health of the patient.

Conclusion

Although panoramic radiographs are not used as a screening tool for carotid artery disease, they do offer the opportunity for early diagnosis of carotid artery calcifications. Because they are inexpensive, readily available, and noninvasive, panoramic radiographs should be taken regularly for patients presenting in the dental office as high risk for cardiovascular disease. Hygienists should be comfortable identifying normal anatomy of the head and neck as well as provide differential diagnosis for anomalies. Being one of the most visited health-care professionals, hygienists are at an advantage to discuss overall health and recommend lifestyle changes, or, if more severe, a referral to the patient's physician. Working together, hygienists and physicians can initiate interventions while disorders are still incipient, ensuring preservation of the patient's quality of life at an accessible cost. A proper referral to the patient's physician is now considered the standard of care.

REFERENCES

1. Tiller R, Bengel W, Rinke S, Ziebolz D. Association between carotid area calcifications and periodontal risk: a cross sectional study of panoramic radiographic findings. *BMC Cardiovasc Disord.* 2011;11:67. doi:10.1186/1471-2261-11-67
2. Hosokawa S, Kawai N, Sato M, et al. Optimal contrast material concentration for distinguishing among carotid artery lumen, carotid stent, and neck in cone-beam computed tomography during carotid angiography: basic and clinical studies. *Jpn J Radiol.* 2012;30(4):358-364. doi:10.1007/s11604-011-0048-1
3. Garoff M, Ahlqvist J, Jäghagen EL, et al. Carotid calcification in panoramic radiographs: radiographic appearance and the degree of carotid stenosis. *Dentomaxillofac Radiol.* 2016;45(6):1-6. doi:10.1259/dmfr.20160147
4. Honan L. *Focus on Adult Health: Medical-Surgical Nursing.* 2nd ed. Lippincott Williams & Wilkins; 2019.
5. Norris TL. *Porth's Pathophysiology: Concepts of Altered Health States.* 10th ed. Wolters Kluwer; 2019.
6. Baroncini LA, Filho AP, Ramos SG, et al. Histological composition and progression of carotid plaque. *Thromb J.* 2007;5(1):4. doi:10.1186/1466-9560-5-4
7. Redgrave JN, Lovett JK, Gallagher PJ, Rothwell PM. Histological assessment of 526 symptomatic carotid plaques in relation to the nature and timing of ischemic symptoms: the Oxford plaque study. *Circulation.* 2006;113(19):2320-2328. doi:10.1161/CIRCULATIONAHA.105.589044
8. de Weerd M, Greving JP, de Jong AW, Buskens E, Bots ML. Prevalence of asymptomatic carotid artery stenosis according to age and sex: systematic review and metaregression analysis. *Stroke.* 2009;40(4):1105-1113. doi:10.1161/STROKEAHA.108.532218
9. Hinkle JL, Cheever KH. *Brunner & Suddarth's Textbook of Medical-Surgical Nursing.* 14th ed. Wolters Kluwer; 2018.
10. Song Y, Kim JG, Cho HJ, Kim JK, Suh DC. Evaluation of cerebral blood flow change after cigarette smoking using quantitative MRA. *PLoS One.* 2017;12(9):e0184551. doi:10.1371/journal.pone.0184551
11. Tobacco free initiative. World Health Organization. 2020. http://www.who.int/tobacco/about/en/
12. Heart Healthy Power Foods. Cleveland Clinic. https://my.clevelandclinic.org/health/articles/17380-heart-healthy-power-foods
13. Should you take a statin to prevent a heart attack or stroke? Harvard Health Publishing. January 2014. https://www.health.harvard.edu/heart-attack/should-you-take-a-statin-to-prevent-a-heart-attack-or-stroke
14. Centers for Disease Control and Prevention. Million hearts: strategies to reduce the prevalence of leading cardiovascular disease risk factors—United States, 2011. *MMWR Morb Mortal Wkly Rep.* 2011;60(36):1248-1251.
15. Bertoluci MC, Pimazoni-Netto A, Pires AC, et al. Diabetes and cardiovascular disease: from evidence to clinical practice - position statement 2014 of Brazilian Diabetes Society. *Diabetol Metab Syndr.* 2014;6:58. Published 2014 May 20. doi:10.1186/1758-5996-6-58
16. Bennett JM, Rodrigues IM, Klein LC. Effects of caffeine and stress on biomarkers of cardiovascular disease in healthy men and women with a family history of hypertension. *Stress Health.* 2013;29(5):401-409. doi:10.1002/smi.2486
17. Wolberg AS. Primed to understand fibrinogen in cardiovascular disease. *Arterioscler Thromb Vasc Biol.* 2016;36(1):4-6. doi:10.1161/ATVBAHA.115.306754
18. Newlin K. The keys to preventing heart disease and strokes. *Calif Dent Hyg Assoc J.* 2014;31(2):18-20.
19. Iannucci JM, Howerton LJ. *Dental Radiography: Principles and Techniques.* Elsevier; 2017.
20. American Dental Association Council on Scientific Affairs. Dental radiographic examinations: recommendations for patient selection and limiting radiation exposure. Revised 2012. https://www.ada.org/~/media/ADA/Member%20Center/FIles/Dental_Radiographic_Examinations_2012.ashx
21. Ohba T, Takata Y, Ansai T, et al. Evaluation of calcified carotid artery atheromas detected by panoramic radiograph among 80-year-olds. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2003 96(5):647-650. doi:10.1016/j.tripleo.2003.07.001
22. Perschbacher S. Interpretation of panoramic radiographs. *Aust Dent J.* 2012 Mar;57 Suppl 1:40-45. doi:10.1111/j.1834-7819.2011.01655.x
23. Gustafsson N, Ahlqvist J, Näslund U, et al. Associations among periodontitis, calcified carotid artery atheromas, and risk of myocardial infarction. *J Dent Res.* 2020;99(1):60-68. doi:10.1177/0022034519885362
24. Bengtsson VW, Persson GR, Renvert S. Assessment of carotid calcifications on panoramic radiographs in relation to other used methods and relationship to periodontitis and stroke: a literature review. *Acta Odontol Scand.* 2014;72(6):401-412. doi:10.3109/00016357.2013.847489
25. Bayer S, Helfgen EH, Bös C, et al. Prevalence of findings compatible with carotid artery calcifications on dental panoramic radiographs. *Clin Oral Investig.* 2010 15(4):563–569. doi:10.1007/s00784-010-0418-6
26. Borba DL, Hipólito UV, Pereira YCL. Early diagnosis of atherosclerosis with panoramic radiographs: a review. *J Vasc Bras.* 2016;15(4):302-307. doi:10.1590/1677-5449.002316
27. Arora P, Umarji H. Can carotid stenosis be predicted by dental radiographs? *Internet J Int Med.* 2009;9(1):1-7.
28. Guimarães Henriques JC, Kreich EM, Helena Baldani M, et al. Panoramic radiography in the diagnosis of carotid artery atheromas and the associated risk factors. *Open Dent J.* 2011;5:79-83. doi:10.2174/1874210601105010079
29. Tamura T, Inui M, Nakase M, et al. Clinicostatistical study of carotid calcification on panoramic radiographs. *Oral Dis.* 2005;11(5):314-317. doi:10.1111/j.1601-0825.2005.01125.x
30. Cohen SN, Friedlander AH, Jolly DA, Date L. Carotid calcification on panoramic radiographs: An important marker for vascular risk. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2002;94(4):510-514. doi:10.1067/moe.2002.125580
31. Rydén L, Buhlin K, Ekstrand E, et al. (2016). Periodontitis increases the risk of a first myocardial infarction: A report from the PAROKRANK study.

Circulation. 2016;133(6):576-583. doi:10.1161/CIRCULATIONAHA.115.020324

32. Boyd LD, Mallonee LF, Wyche CJ. *Wilkins' Clinical Practice of the Dental Hygienist.* 13th ed. Jones & Bartlett Learning; 2020:472.
33. Gehrig JS, Shin DE, Willmann DE. *Foundations of Periodontics for the Dental Hygienist.* 5th ed. Wolters Kluwer; 2019:305,309,381.
34. Periodontal disease fact sheet. American Academy of Periodontology. Accessed March 25, 2020. https://www.perio.org/newsroom/periodontal-disease-fact-sheet
35. Kebschull M, Demmer RT, Papapanou PN. "Gum bug, leave my heart alone!"—Epidemiologic and mechanistic evidence linking periodontal infections and atherosclerosis. *J Dent Res.* 2010;89(9):879-902. doi:10.1177/0022034510375281
36. Survey: More Americans want to visit the dentist. American Dental Association. March 21, 2018. Accessed March 26, 2020. https://www.ada.org/en/publications/ada-news/2018-archive/march/survey-more-americans-want-to-visit-the-dentist
37. Palmer P. Promoting positive change: dental hygienists and patient motivation. *Access.* 2003;17(6);16-24.
38. Smith HA, Smith ML. The role of dentists and primary care physicians in the care of patients with sleep-related breathing disorders. *Front Public Health.* 2017;5:137. doi:10.3389/fpubh.2017.00137
39. Carotid artery disease. Mayo Clinic. Accessed March 25, 2020. https://www.mayoclinic.org/diseases-conditions/carotid-artery-disease
40. Lanzino G, Rabinstein AA, Brown RD. Treatment of carotid artery stenosis: medical therapy, surgery, or stenting? *Mayo Clin Proc.* 2009;84(4):362-368. doi:10.1016/S0025-6196(11)60546-6

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Notes

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QUESTIONS

1. Adequate blood flow through the carotid arteries is necessary to:
   - A. Provide complete drainage of deoxygenated blood from the brain
   - B. Provide oxygenated blood to the brain
   - C. Foster lymph drainage from the brain, face, and neck
   - D. Allow nutrient-rich blood to flow from the brain to the heart

2. Which of the following is a modifiable risk factor associated with atherosclerosis?
   - A. Age
   - B. Genetics
   - C. Diet
   - D. Gender

3. Calcification or plaque deposits in the arteries are dangerous because they do all of the following except:
   - A. May pull away from the arterial wall, causing a tear and hemorrhage
   - B. Narrow the diameter of the artery
   - C. Potentiate a fight-or-flight response
   - D. Provide a surface attractive to thrombi

4. Histology of a plaque is determined by:
   - A. Examination upon removal
   - B. Bilateral carotid ultrasound
   - C. Venous Doppler scan
   - D. Blood flow analysis

5. As a modifiable risk factor, how does nicotine affect arteries?
   - A. Dilates the diameter
   - B. Decreases the blood flow
   - C. Increases the speed of blood flow
   - D. Decreases the rate of the heart

6. An individual seeking to decrease cholesterol can start with diet modification. Which item should be limited?
   - A. Fruits
   - B. Vegetables
   - C. Fish
   - D. Red meat

7. Hypertension negatively impacts the cardiovascular system in the following way:
   - A. Causes the arteries to enlarge
   - B. Causes the heart rate to increase
   - C. Causes the heart rate to decrease
   - D. Causes the arteries to narrow

8. When stress causes an increase in fibrinogen levels, what happens?
   - A. The individual is at an increased risk for anxiety.
   - B. The individual is at an increased risk for an allergic reaction.
   - C. The individual is at an increased risk for vessel occlusion.
   - D. The individual is at an increased risk for blood glucose elevation.

9. In order to decrease obesity, which of the following practices is least helpful?
   - A. Incorporating as much technology into the lifestyle as possible
   - B. Focusing on reasonable lifestyle activity changes
   - C. Identification of factors that influence sedentary lifestyle
   - D. Walking when possible

10. Detecting carotid artery stenosis in a three-dimensional image at the dental setting can be best accomplished through:
    - A. Ultrasonography
    - B. Panoramic radiograph
    - C. Cone-beam computed tomography
    - D. Magnetic resonance imaging

11. What radiographs are recommended by the ADA for new patients with permanent dentition and no history of other circumstances?
    - A. Panoramic and posterior bitewings
    - B. Posterior bitewings
    - C. Panoramic
    - D. Panoramic and periapicals

12. All of the following can be viewed on a panoramic radiograph except:
    - A. Osseous structures of the maxillofacial region
    - B. Soft tissue and air spaces
    - C. Alveolar process of the teeth
    - D. Interproximal caries

13. Calcifications in the carotid artery can present on a radiograph as:
    - A. Nodular masses
    - B. Radiolucent
    - C. Homogeneous
    - D. Well-defined

14. Findings compatible with carotid calcifications include all of the following except:
    - A. Sialolith
    - B. Epiglottis
    - C. External auditory meatus
    - D. Calcified lymph nodes

15. The bacteria associated with periodontal disease are predominately gram-negative anaerobic bacteria, including:
    - A. *Porphyromonas gingivalis*
    - B. *Lactobacillus*
    - C. *Streptoccus mutans*
    - D. *Bifidobacterium dentium*

ONLINE COMPLETION

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QUESTIONS

16. Individuals aged 65 and older are at an increased risk of developing periodontal disease. The rate increases by ___% from age 30 to age 65.
    A. 15
    B. 23
    C. 30
    D. 34

17. Which systemic pathology has been shown to have a relation with oral inflammation?
    A. Arthritis
    B. Macular degeneration
    C. Scleroderma
    D. Lupus

18. What is the term that refers to periodontal pocket microorganisms traveling through the bloodstream?
    A. Cystitis
    B. Meningitis
    C. Bacteremia
    D. Pneumonia

19. Patients presenting with periodontitis and carotid calcifications are at higher risk of having a stroke. This is especially true for those with severe pocketing and bone loss.
    A. Both statements are true.
    B. Both statements are false.
    C. The first statement is true; the second statement is false.
    D. The first statement is false; the second statement is true.

20. Dental hygienists are responsible for all of the following except:
    A. Providing patient education
    B. Assessing intra- and extraoral findings
    C. Performing nonsurgical therapy
    D. Diagnosing radiographs

21. The ADA reports what percentage of Americans visit the dentist every six months?
    A. 30%
    B. 20%
    C. 50%
    D. 40%

22. Dental hygienists play a vital role in the health-care profession because they:
    A. Routinely see patients and can identify undetected health issues
    B. Provide detailed instruction for postoperative care
    C. Recognize and record anatomy and pathology
    D. Work with patients at high risk for periodontal disease

23. Which of the following is the most effective method for hygienists to educate patients on the association between oral and systemic health?
    A. Lecture patients at hygiene visits
    B. Attend health fairs
    C. Provide brochures
    D. Collaborate with medical professionals

24. A primary health-care provider helps patients adhere to a healthy lifestyle. One way providers can do this is to minimize nonmodifiable risk factors.
    A. Both statements are true.
    B. Both statements are false.
    C. The first statement is true; the second statement is false.
    D. The first statement is false; the second statement is true.

25. Referrals provided from a dental office for carotid stenosis should first be sent to:
    A. A cardiologist
    B. The patient's primary health-care provider
    C. A cardiovascular surgeon
    D. A pulmonologist

26. The goal of preserving blood flow through the carotid artery can be accomplished by all the following except:
    A. Stenting
    B. Endarterectomy
    C. Thrombolitic medicine
    D. Angioplasty

27. In what percentage of the population are carotid calcifications detected on a panoramic radiograph?
    A. 2–5%
    B. 6–10%
    C. 12–15%
    D. 18–20%

28. Which of the following questions concerning dental and overall health should the dental hygienist not ask?
    A. Which type of insurance does the patient use?
    B. What is the patient's overall medical history?
    C. What is the patient's overall dental health history?
    D. What concerns does the patient have related to their dental health?

29. In the United States, what is the third major cause of death in adults?
    A. Stroke
    B. Accidents
    C. Cancer
    D. Viruses

30. Asymptomatic carotid artery stenosis is significant because:
    A. The treatment is expensive
    B. The individual does not show symptoms
    C. The individual is likely to contract cancer
    D. No treatment is available

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ANSWER SHEET

Carotid stenosis and the dental patient: An overview for the dental hygienist

NAME: TITLE: SPECIALTY:

ADDRESS: EMAIL: AGD MEMBER ID (IF APPLIES):

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Educational Objectives

1. Locate physical landmarks associated with carotid stenosis
2. Identify pathology associated with carotid stenosis
3. List risk factors associated with carotid stenosis
4. Discuss the role of the hygienist in detecting blockage visible on a panoramic radiograph
5. Instruct the patient on the importance of timely follow-up care with their primary health-care provider
6. Facilitate a referral if the patient does not have a primary health-care provider established

Course Evaluation

1. Were the individual course objectives met?

   Objective #1: Yes No Objective #3: Yes No Objective #5: Yes No

   Objective #2: Yes No Objective #4: Yes No Objective #6: Yes No

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

2. To what extent were the course objectives accomplished overall? 5 4 3 2 1 0
3. Please rate your personal mastery of the course objectives. 5 4 3 2 1 0
4. How would you rate the objectives and educational methods? 5 4 3 2 1 0
5. How do you rate the author's grasp of the topic? 5 4 3 2 1 0
6. Please rate the author's effectiveness. 5 4 3 2 1 0
7. Was the overall administration of the course effective? 5 4 3 2 1 0
8. Please rate the usefulness and clinical applicability of this course. 5 4 3 2 1 0
9. Please rate the usefulness of the references. 5 4 3 2 1 0
10. Do you feel that the references were adequate? Yes No
11. Would you take a similar course on a different topic? Yes No
12. If any of the continuing education questions were unclear or ambiguous, please list them.

    _____

13. Was there any subject matter you found confusing? Please describe.

    _____

14. How long did it take you to complete this course?

    _____

15. What additional dental continuing education topics would you like to see?

    _____

    _____

Mail/fax completed answer sheet to:

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6.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		21.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		22.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
15.	Ⓐ	Ⓑ	Ⓒ	Ⓓ		30.	Ⓐ	Ⓑ	Ⓒ	Ⓓ

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