Dentistry

Activity for 2018

Activity No: B10 (18) 2022

Topic
Dental Imaging

Article
How new dental imaging can save the lives of your patients

Speciality
Dental Radiology

Approved for ONE (1) Clinical Continuing Educational Unit (CEU)
How new dental imaging can save the lives of your patients

October 3, 2017
By Oksana Bandura, MD

Can dentists prevent a stroke or a hip fracture in their patients? Dr. Oksana Bandura explains how computer-aided diagnosis (CAD) systems based on dental image analysis have the potential to become powerful tools to expand the scope of the panoramic x-ray exam and make it a relevant screening method for osteoporosis and carotid artery calcification.

Editor's note: This article first appeared in DE's Breakthrough Clinical with Stacey Simmons, DDS. Find out more about the clinical specialties newsletter created just for dentists, and subscribe here.

CAN DENTISTS PREVENT a stroke or a hip fracture in their patients? Yes, and with the help of an intelligent electronic dental imaging advisor, this will be easy even for dentists who have just started their practices.

Computer-aided diagnosis (CAD) systems based on image analysis algorithms can help dental radiologists diagnose various oral pathologies from dental caries to cancer. Locating regions of interest (ROI), spotting suspicious signs, and classifying the findings—both in plain and 3-D images—dental image analysis systems offer practitioners a valuable second opinion, for example, in diagnosing pulpitis and periodontitis.

But the scope of dental CAD applications isn’t limited just to oral cavity. Several recent studies have confirmed that dental CAD systems can bring extra benefits when programmed to look for external signs of pathology in panoramic dental radiographs that contain boundaries of many head and neck structures. If the developers of dental image analysis algorithms design them to look for additional specific ROI, this will allow detection of more pathologies in one image, thus increasing the advantages both for dentists and their patients.
Maxillary sinusitis

Maxillary sinusitis is often caused by a dental pathology when affected roots are situated too close to the maxillary sinus (or even penetrate its floor), and this discovery will affect the treatment plan. Regardless of its cause, maxillary sinusitis usually can be detected in panoramic radiographs. Experienced dentists are usually familiar with the signs, but beginning dentists may overlook maxillary sinusitis and need additional support to detect it. A recent research study has shown that CAD systems work well as a second opinion for inexperienced dentists, increasing their diagnosis accuracy. (1) The proposed technique is based on the registration of symmetrical sinuses to determine any possible difference in the opacity. While the researchers achieved the sensitivity of 77.6%, specificity of 69.4%, and accuracy of only 73.5%, the study showed that the use of dental image analysis can still make a difference for novice dentists.

Osteoporosis

Osteoporosis is a medical condition characterized by the loss of bone mineral density which increases both bone fragility (bad for patients) and bone radiolucency (good for diagnosticians). It is called a "silent" disease, because patients do not feel any disturbances until one of their bones suddenly breaks. This makes screening for osteoporosis an essential part of regular health checkups in elderly people.

The current gold standard in osteoporosis diagnosis is dual energy x-ray absorptiometry (DXA) of the hip and lumbar spine, but this method requires special equipment that limits DXA availability for the majority of patients. To make diagnosis of osteoporosis easier, it may be worth turning to more common and less expensive methods. Since it has been proved that measuring bone mineral density (BMD) in the area of the mandible also provides accurate results in osteoporosis detection, panoramic dental x-rays have become a reasonable option for osteoporosis screening. And while measuring BMD might be not so easy for dental radiologists, CAD systems can help them a lot by evaluating BMD automatically.

One of the most successful studies in this area has shown an 85.71% accuracy, 90.91% sensitivity, and 66.67% specificity in osteoporosis detection using a support vector machine (SVM) with kernel function multilayer perceptron as a classification method. (2)

Carotid artery calcification

Carotid artery calcification is an important sign that allows early diagnosis of another "silent" disease leading to severe complications—carotid artery disease. Carotid artery disease is a narrowing of carotid arteries that reduces the blood flow carrying oxygen and nutrients to the brain and often results in acute cerebrovascular disorder, also known as stroke. The main cause leading to this condition is arteriosclerosis, a hardening and thickening of the arterial walls often accompanied by the buildup of fatty deposits (atherosclerosis) and artery calcification (CAC).

The good thing is that carotid artery calcification can be spotted in dental panoramic x-ray images, which can be used for CAC screening. Of course, dentists mostly focus on dental pathology and may easily overlook the radiographic signs of carotid artery calcification. Here, the CAD system that is programmed to recognize these signs can become a lifesaver. Recently, a Japanese collaboration developed an image analysis method for automated CAC detection in panoramic radiographs, achieving a sensitivity of 93.6%. (3) To obtain this great
result, the researchers first used a grayscale top-hat filter to detect the candidates for CAC signs, and then applied a rule-based approach and SVM to decrease the number of false-positive findings.

**Dental x-ray as a screening method**

While the utility of CAD systems as a support in maxillary sinusitis diagnosis may be argued by experienced dental practitioners, the use of dental image analysis for automated detection of osteoporosis and carotid artery calcification can make a difference regardless of a dentist’s skill level. This is of particular importance in cases of symptomless diseases with potential severe complications, such as osteoporosis leading to immobilization or carotid artery calcification resulting in apoplexy and sometimes even death. In these cases, a CAD system based on dental image analysis can become a powerful tool that expands the scope of panoramic x-ray examination and makes it a relevant screening method for osteoporosis and carotid artery calcification.

**References**


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**Oksana Bandura, MD**, is a general radiologist with more than three years of experience in dental radiology. She currently works as a medical and industrial image analysis researcher at [ScienceSoft](#), a software development and consulting company. Based on the knowledge and skills she gained in clinical radiology, as well as working experience in information technology, Dr. Bandura monitors the computer-aided diagnosis industry and writes articles on the state-of-the-art in computer vision and its applications in health care. You may contact her at [obandura@scnsoft.com](mailto:obandura@scnsoft.com).
QUESTIONNAIRE
B10(18)

How new dental imaging can save the lives of your patients

INSTRUCTIONS
• Read through the article and answer the multiple-choice questions provided below. There is only ONE correct answer to each question.

Question 1: Which one of the following is TRUE regarding computer-aided diagnosis (CAD) systems?

A: They offer practitioners a valuable second opinion in diagnosing a wide range of systemic diseases
B: The scope of dental CAD applications is limited to the oral cavity
C: They will allow detection of more pathologies in one image, thus increasing the advantages both for dentists and their patients

Question 2: When can dental pathology lead to maxillary sinusitis?

A: When affected roots are situated too close to the maxillary sinus
B: When it is mistakenly diagnosed as cancer
C: When the roof of the maxillary sinus is perforated
D: None of the above

Question 3: Which one of the following is the gold standard in the diagnosis of osteoporosis?

A: Measuring bone mineral density (BMD) of the mandible
B: Dual energy x-ray absorptiometry (DXA) of the mandible
C: Full body examination with standard radiographs
D: Dual energy x-ray absorptiometry (DXA) of the hip and lumbar spine

Question 4: Which one of the following is a potential complication of carotid artery calcification?

A: Myocardial infarction
B: Calcific tendonitis
C: Acute cerebrovascular disorder
D: Renal calcium stones

Question 5: Is it TRUE or FALSE that the limitation of CAD systems is that it is only indicated to diagnose symptomatic diseases with potential severe complications, such as osteoporosis leading to immobilization or carotid artery calcification resulting in apoplexy?

A: TRUE
B: FALSE

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# ANSWER SHEET

**B10(18)**

How new dental imaging can save the lives of your patients

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