**Is the initiation of non-invasive dental hygiene procedures* contra-indicated?** Yes, if there is the potential for electromagnetic interference (EMI) from dental/dental hygiene equipment (such as magnetic headrests or battery-operated curing lights) that could affect operation of a CIED and/or if there are questions or uncertainties regarding comorbidities (including underlying arrhythmia). However, most dental/dental hygiene procedures do not involve strong electromagnetic signals and thus are unlikely to interfere with CIEDs.

- **Is medical consult advised?** Yes, consultation with patient/client’s cardiologist or the cardiology unit responsible for follow-up of the CIED is recommended when planning therapeutic services. If dental/dental hygiene equipment in the office has the potential to cause EMI that interferes with the operation of a patient/client’s CIED, the consult should clarify the type of implanted cardiac device as well as whether it is unipolar or bipolar (with unipolar devices providing fewer safeguards against EMI). As well, consultation may be warranted to determine the severity and stability of the patient/client’s medical condition(s), as well as to determine appropriate timing for dental hygiene treatment.

**Is the initiation of invasive dental hygiene procedures contra-indicated?** Yes, if there is the potential for electromagnetic interference (EMI) from dental/dental hygiene equipment that could affect operation of a CIED and/or if there are questions or uncertainties regarding concomitant morbidities (including underlying arrhythmia). However, most dental/dental hygiene procedures do not involve strong electromagnetic signals and thus are unlikely to interfere with CIEDs.

- **Is medical consult advised?** ........................................... See above. Also, consultation may be necessary to confirm there are no indications for antibiotic prophylaxis.

- **Is medical clearance required?** ...................................... Yes, if there is the potential for equipment-related electromagnetic interference of the implanted cardiac device. Also, clearance may be required for comorbid conditions or the underlying disease entity that led to implantation of the cardiac device (e.g., myocardial infarction).

- **Is antibiotic prophylaxis required?** ................................. No, not generally (for the prevention of infective endocarditis) for cardiac pacemakers (intravascular or epicardial) or ICDs implanted more than 6 months ago. Furthermore, antimicrobial prophylaxis is not recommended for dental/dental hygiene invasive procedures to prevent CIED infection. However, consultation with the patient/client’s primary care physician or cardiologist may be necessary to confirm that there are no other indications for antibiotic prophylaxis.

- **Is postponing treatment advised?** ................................. Potentially, if the CIED was recently placed (e.g., within the last 6 months). Also, the dental hygienist should avoid the use of equipment that poses risk of EMI in a patient/client with a CIED.

**Oral management implications**

- Prior to using an ultrasonic or other equipment that poses potential EMI risk, the dental hygienist should ask each patient/client if a cardiac pacemaker or implantable cardioverter defibrillator is present. Similarly, dental hygienists or other healthcare workers with CIEDs should be aware of their own implanted devices and exercise caution in using equipment that poses potential EMI risk.
Disease/Medical Condition

**Cardiac Implantable Electronic Devices**

(also known as “cardiovascular implantable electronic devices”, “CIEDs”, and “implanted cardiac devices”; includes implanted cardiac pacemakers [also known as “permanent pacemakers” or PPMs], cardiac resynchronization therapy devices [CRTs], and implantable cardioverter defibrillators [ICDs; also known as “automated implantable cardioverter defibrillators” or AICDs])

### Oral management implications (con’t)

- Electromagnetic interference from some dental/dental hygiene equipment can temporarily interfere with the function of CIEDs, posing risk of inhibition of cardiac pacing, asynchronous pacing, or inappropriate shocks. However, the extant literature on EMI is conflicting and controversial (much being based on in vitro, rather than in vivo, observations).

- Patients/clients are usually issued a CIED manufacturer’s identification card by their cardiologist, which provides information on model, mode of operation, serial number, manufacturer, and date of implantation, as well as medical contacts. This information, which should be carried by the patient/client and recorded by the oral health professional, will assist in determining whether dental hygiene treatment should proceed. The manufacturers of cardiac devices and/or dental equipment may be contacted for advice regarding the possibility of EMI and precautionary measures.

- Clinical relevance of EMI depends on various factors, including the type of dental equipment used, the application distance, and the type and manufacturer of the CIED.

- Dental equipment that potentially poses EMI risk includes older ferromagnetic/magnetostrictive ultrasonic scalers (which may cause single beat inhibition with unipolar pacemakers\(^1\)), ultrasonic bath cleaners, electrosurgical units, electronic apex locators, electrical pulp testers, dental chairs with magnetic headrests, and battery-operated curing lights. As well, electrical cords should not be placed over the patient/client’s chest.

- “Safe” procedures/equipment generally include dental radiographs, cone beam CT\(^3\), dental hand pieces, composite curing lights, sonic scalers, and piezoelectric scalers. Newer ultrasonic scalers are unlikely to have any adverse effects on patients/clients with newer bipolar (as distinct from unipolar) implanted cardiac devices. As well, transcutaneous electrical nerve stimulators (TENS) are unlikely to interfere with an implanted cardiac device provided the equipment is not placed directly over the implant site.

- Dental/dental hygiene equipment that poses no EMI risk should be substituted for instruments that pose potential risk. For example, because ferromagnetic/magnetostrictive instruments may affect unipolar pacemakers, the dental hygienist can instead use sonic or piezoelectric instruments as an adjunct to manual debridement.

- Contrary to former thinking, lead apron coverage does not provide additional protection from EMI; such coverage provides protection from ionizing radiation only.

- Improvements in the design, manufacture, and protective shielding of CIEDs means that adverse clinical outcomes are very unlikely in the dental hygiene or dental setting. Most dental/dental hygiene procedures do not involve strong electromagnetic signals. However, caution should be exercised when operating equipment that can potentially generate EMI.

- If pacemaker malfunction is suspected in the dental hygiene or dental office setting, suspected sources of EMI (such as ultrasonic units) should be turned off and the medical emergency protocol should be activated. In most circumstances, the implanted cardiac device will return to normal function when interference ceases. All suspected interference incidents should be reported to the patient/client’s cardiologist.

- While electric and battery-powered toothbrushes are generally considered safe, a precaution was issued by a leading cardiac implant manufacturer relating to the use of sonic toothbrushes with a battery charger. The manufacturer recommended that patients/clients maintain a distance of at least 6 inches (i.e., 15.2 cm) between the battery charger unit and the implanted device, as well as a distance greater than 1 inch (i.e., 2.5 cm) between the toothbrush and the implanted device.

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1 Magnetostrictive ultrasonic instruments are not generally contraindicated for use on patients/clients with a bipolar pacemaker or an ICD.

2 Single beat inhibition is not considered clinically significant by some pacemaker manufacturers. However, at least one manufacturer recommends caution when using ultrasonic scalers, and discontinuing use if the patient/client with an implanted cardiac device feels lightheaded or experiences an irregular heartbeat.

3 CT = computerized axial tomography

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Oral management implications (con’t)

- The dental hygienist should recognize that the presence of an implanted cardiac device signals a cardiovascular condition that may require treatment modifications. Baseline vital signs (including blood pressure) and ongoing monitoring are prudent in the office setting.
- Stress reduction protocols should be considered for all patients/clients with CIEDs (particularly those with ICDs) to reduce the risk of cardiovascular effects caused by stress during dental hygiene or dental treatment. Administration of exogenous epinephrine and other vasoconstrictors (e.g., in local anaesthetics) should be limited to minimize risk of arrhythmias and other adverse events.
- In the event of a CIED malfunctioning during a dental hygiene appointment, all sources of potential electromagnetic interference should be turned off and emergency medical services (EMS) protocol may need to be activated should function not be quickly restored.
- In the event of a cardiovascular emergency requiring the use of an automated external defibrillator (AED) for a patient/client with an ICD or CRT, the AED pads should be placed as far away from the implanted device as possible (ideally 13 cm at a minimum). The patient/client should also be advised to undergo an evaluation of the implanted device by his/her cardiologist to ensure that damage has not occurred.

Oral manifestations

- None specific to CIEDs; however, there may be oral side effects from concurrent medications such as anti-hypertensives or anti-arrhythmics.

Related signs and symptoms

- CIEDs are used to improve the function of an electrically malfunctioning heart, thus improving quality of life for eligible persons suffering from heart failure, ventricular dyssynchrony, or electrical instability of the myocardium following a myocardial infarction or as a result of other cardiac abnormalities. They typically consist of a battery-powered generator implanted subcutaneously (most commonly near the clavicle in adults, but in children they may also be implanted in the abdomen), with electrode leads (wires) that connect to various areas of the heart via the venous circulation. Advances in technology of CIEDs means that today’s cardiac resynchronization therapy devices and ICDs are small computers or microprocessors, which often provide combination features.

4. For example, a patient/client with an ICD may be on concomitant anticoagulant therapy.
5. Stress reduction protocols include the establishment of a good rapport with the patient/client; suitable appointment time (e.g., in the morning) and duration (i.e., short as possible with termination if patient/client develops signs/symptoms of fatigue or procedure intolerance); comfortable chair position; and sedation if necessary.
6. Such electrical instability can lead to life-threatening ventricular tachycardia and/or fibrillation.
7. CRTs are pacemakers that re-synchronize the heart’s contractions caused by arrhythmias, essentially “re-tuning” electrical conduction in the heart. They are most commonly used to manage bradycardia (slow heart rate).
8. ICDs are used to treat potentially life-threatening tachyarrhythmia (abnormally high heart rate). In newer generation ICD combination units, if an initial low energy electrical pulse does not restore normal rhythm, defibrillation of the heart will then occur by the sending of higher energy electrical pulses.

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### Related signs and symptoms (con’t)

- In a demand pacemaker, the leads monitor heart rate and deliver a pacing impulse only when the rhythm of the heart falls into a predetermined abnormal range. In the less common fixed-rate pacemaker, continuous pacing of the heart rate occurs regardless of the heart’s inherent rhythm. In an implantable cardioverter defibrillator, a precisely calibrated cardioversion/defibrillation shock can be delivered upon detection of an abnormal heart rate (i.e., ventricular tachycardia or fibrillation) to stop abnormal electrical activity and restore normal heart rate.

- Cardiac implantable electronic devices are becoming increasingly common given an aging population and growing adoption of technology. More than 3 million persons globally, including more than 500,000 in North America, have implanted cardiac pacemakers.

- Pacemakers and ICDs are sensitive to strong electromagnetic signals that can temporarily interfere with their function. ICDs on the market today are bipolar⁹, having enhanced protection and filtering against EMI. Pacemakers may be either bipolar or unipolar¹⁰, with unipolar devices typically providing less protection and filtering against EMI.

- In addition to patient/client reporting of unusual activity or discomfort from the implanted device, signs/symptoms of pacemaker malfunction include: difficulty breathing; light-headedness; dizziness; alterations in pulse rate; swelling in extremities (particularly in the ankles and feet); chest pain; prolonged hiccoughing; and muscle twitching.

### References and sources of more detailed information

- College of Dental Hygienists of Ontario

- College of Dental Hygienists of Manitoba

- College of Dental Hygienists of British Columbia

- American Heart Association
  [http://www.heart.org/HEARTORG/Conditions/Arrhythmia/PreventionTreatmentofArrhythmia/Devices-that-may-Interfere-with-Pacemakers_UCM_302013_Article.jsp#V4VXk6sondl](http://www.heart.org/HEARTORG/Conditions/Arrhythmia/PreventionTreatmentofArrhythmia/Devices-that-may-Interfere-with-Pacemakers_UCM_302013_Article.jsp#V4VXk6sondl)


  [http://www.jcda.ca/article/b113](http://www.jcda.ca/article/b113)

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9. The terms “bipolar” and “unipolar” have superseded the older terms “shielded” and “unshielded” when referring to electronic filter and insulator safeguards incorporated into implanted cardiac devices.

10. In a unipolar pacemaker, the leads stimulate only one chamber of the heart. In a bipolar pacemaker, one lead is usually inserted into the right atrium, and the second lead is positioned with the right ventricle.

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Disease/Medical Condition

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References and sources of more detailed information (con't)

- Update on Cardiovascular Implantable Electronic Device Infections and Their Management: A Scientific Statement From the American Heart Association [http://circ.ahajournals.org/content/121/3/458.full.pdf]

* Includes oral hygiene instruction, fitting a mouth guard, taking an impression, etc.

** Ontario Regulation 501/07 made under the Dental Hygiene Act, 1991. Invasive dental hygiene procedures are scaling teeth and root planing, including curetting surrounding tissue.

Date: July 14, 2016