PATIENTS WITH

pacemakers

Desrin Dionne Conteh EDT* clarifies the issues surrounding artificial pacemakers and the treatment of patients within dental practice.

An adequate heartbeat

An artificial pacemaker is a medical device which maintains an adequate heartbeat by delivering electrical impulses to the heart. They are indicated when the natural impulses (from the sinoatrial node [SAN]) are absent or too slow. Most recent ones are controlled externally and some include an inbuilt defibrillator.¹

Around 25,000 people in the UK have a pacemaker fitted each year.² Pacemakers are fitted to people who experience symptoms of heart failure. A common use is for cardiac arrhythmia (irregular heartbeat).

Electromagnetic interference occurs when one electromagnetic field from one device interferes with the operation of another device.

There do not appear to be any clear guidelines on treating patients with fitted cardiac pacemakers and defibrillators. In November 2007 a paper in the British Dental Journal said 'To our knowledge, no previous studies have been performed on the possible effects of dental devices on ICDs³ (implantable cardioverter defibrillators).

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Types of pacemaker

Some pacemakers are used during emergency lifesaving procedures, such as the external defibrillator.

Pacemakers work by sensing the beats of the heart, and stimulating the atrial/ventricular chambers when a beat is sensed as missed.

Fitting a pacemaker is a simple 1-2 hour operation carried out under general or local anaesthetic under antibiotic cover.¹

External pacing (temporary)

A pacemaker wire is placed into a cardiac vein and placed into either the right atrium or the right ventricle of the heart. The wire is connected to an external pacemaker. This technique is used as a temporary measure before a permanent pacemaker is implanted.¹ This may be used after types of myocardial infarction (heart attacks).⁴

Internal pacing (permanent)

During surgery, one or more electrode is placed in the heart chamber(s). The attached lead is passed through a suitable vein. The other end of this lead is then connected to the pacemaker body (usually titanium), which is around 4 cm, which is usually placed below the fat of the chest wall often just below the left collar bone.¹ Permanent pacemakers are usually fitted for persistent symptomatic bradycardia.⁴

A biventricular pacemaker (also known as cardiac resynchronisation therapy) is a type of pacemaker which can synchronise both sides of the left ventricle. This is indicated when the two walls of the left ventricle do not contract at the same time, which is the case for 25-50% of heart failure patients. These biventricular pacemakers have at least two leads. They reduce mortality rates and improve quality of life for people with heart failure symptoms.¹

Modern dual chamber pacemakers control the atria and the ventricles. They are more

expensive but improve pumping efficiency and are good for congestive heart failure.

New developments incorporate systems to take into account physical activity by measuring body temperature, CO2 levels and adrenaline levels, all to produce a more natural heart rate.

Unshielded pacemaker

- Older type
- Reliable
- Less insulated
- Still used in some countries.

Shielded pacemaker

- Uses a chamber, filter and isolation circuit to provide shielding to the pacemaker
- More modern
- More technology incorporated.

Most modern devices are now designed with safeguards that include electronic filters or shields that insulate the pacemaker from electromagnetic interference (EMI).⁵

Types of scaler

Sonic

- For example Titan and other air scalers
- Vibrating metal plates
- Low power, 3,000-9,000 cycles per second.

'Sonic scalers do not operate electrically, so they have no effect on pacemakers.'⁶

Ultrasonic

- High power, 25,000-30,000 cycles per second
- High frequency, cavitation (bubbles)
- Piezoelectric eg EMS, Satelac. Vibrations caused by a quartz crystal in the handpiece. Piezoelectric scalers do not produce as much EMI and may be seen as safe to use on shielded pacemakers⁵
- Magnetostrictive eg Cavitron. Uses metal

- stacks in insert to produce vibrations.
- Generates a lot of heat.

C. S. Miller *et al.*⁷ showed that 'Atrial and ventricular pacing were inhibited by electromagnetic interference produced by the electrosurgical unit up to a distance of 10 cm, by the ultrasonic bath cleaner up to 30 cm, and by the magnetorestrictive ultrasonic scalers up to 37.5 cm.'

The ultrasonic scaler emits a large electromagnetic field, which can interfere with older (unshielded) types of pacemaker.⁸

Implications to patients

Electromagnetic interference could cause the pacemaker to:

- Inhibit pacing – stimuli not provided when needed
- Asynchronous pacing – pacing occurs at a fixed rate regardless of the heart's need for therapy
- Inappropriate stimuli – shock therapy provided when not needed.⁸

Modern pacemakers last between 5-12 years; changing them is quite a simple operation but patients may be advised by their cardiologist to avoid dental treatment for a few weeks if possible, or to use antibiotic cover if unavoidable.

The patient should have a Pacemaker Identification Card, listing the doctor, hospital, date, type, etc, which may be useful to dental professionals if we need to correspond with the cardiologist regarding dental treatments.

Patients with congestive heart disease should not be laid flat in the chair due to increased strain on the heart.⁹

Hand scaling

Practices without sonic scalers may prefer to use hand instrumentation on patients with fitted pacemakers.

Patient safety

The field of interference is around 1 metre⁶ so any patients attending the surgery should be kept at least 1 metre away from equipment which may interfere with their pacemaker. This may include avoiding using equipment such as sonic baths until the patient has left the surgery. Some scaler units contraindicate their use on patients with pacemakers fitted.

DENTSPLY 'recommend that the handpiece and cables be kept at least 6-9 inches (15-23 cm) away from any pacemaker and pacemaker leads during use' and also that clinicians should consult the patient's physician.¹⁰

An *in vitro* study showed that the ultrasonic scaler failed to produce EMI at 2.5 cm,³ however,

this was not a study carried out in humans, and the exact type of scaler was not specified.

Magnetostrictive Cavitron-branded scalers may cause single beat inhibition on unipolar (older) pacemakers. Using a lead apron will offer some protection from electrical interference.¹¹ Care must be taken to keep the working end at least 6 inches away from the implant, which would be extremely difficult given the usual site of placement under the left collarbone.

If the patient experiences symptoms such as light-headedness, increased heart rate, a defibrillation shock, or hears beeping tones from their device, increasing the distance between the pacemaker and the source of the EMI will usually allow the device to return to its normal function.⁸ No pacemaker interference has ever been reported to DENTSPLY.¹⁰

The Medicines and Healthcare products Regulatory Agency (MHRA) is an executive agency of the Department of Health. They regulate a wide range of materials and medical devices and are responsible for ensuring that they work safely.¹² The MHRA have not published any incidents of adverse reactions reported, however, they did publish a paper in 2002 identifying a problem with under-reporting of adverse reactions. No alerts were found on the NHS National Patient Safety Agency, who operate a national safety reporting system.

If a practice does not possess a sonic scaler, it would be wise to liaise with the consultant first. Also, obtain full informed consent from the patient, which would involve an explanation of risk versus benefit. If a patient is forewarned of potential symptoms, they can interrupt treatment immediately.

With the increasing evidence emerging of a link between oral health and cardiovascular disease, it is also extremely important to educate patients on the importance of maintaining excellent oral health. Patients with periodontal disease are more likely to experience heart disease, in particular stroke and coronary artery disease.¹³ Antibiotic cover is not recommended unless a doctor says otherwise.⁵ Plain local anaesthetic may be used as a precaution.

Magnets affect pacemakers. A recent article suggests that if a dental chair has a magnetic headrest with a strength over 10 gauss, there may be interference with a pacemaker. However, the magnet is usually in the removable pillow, so it can be taken off and moved away from the patient.¹⁴

Summary

Sonic scalers have been shown not to produce EMI and are safe to use on patients fitted with pacemakers. Other ultrasonic scalers and ultrasonic baths do produce EMI and may pose a risk to such patients. Clear guidelines are

required for dental professionals to adhere to. These may include:

- Remove magnetic pillow from headrest
- Turn off ultrasonic baths
- Sonic scalers are safe to use
- Other scalers should be used with caution – you may need to contact the cardiologist to ask if it is safe to use an ultrasonic scaler on that patient. Also lead aprons may be useful. Keep the tip and lead 6-9 inches away from the implant. Always explain symptoms of interference to the patient
- Date of receipt is not a reliable way of deciding whether the pacemaker is shielded, as unshielded pacemakers are still sometimes used¹¹
- You may want to use a plain local anaesthetic and make sure the patient does not lie completely flat.

- American Heart Association. Artificial Pacemaker. Available online at http://www.heart.org/HEARTORG/Conditions/Arrhythmia/PreventionTreatmentofArrhythmia/Artificial-Pacemaker_UCM_448480_Article.jsp (accessed July 2015).
- British Heart Foundation. Heart Matters: Focus on pacemakers. Available online at <https://www.bhf.org.uk/heart-matters-magazine/medical/pacemakers> (accessed July 2015).
- Brand H S, Entjes M L, Nieuw Amerongen A V, van der Hoeff E V, Schrama T A. Interference of electrical dental equipment with implantable cardioverter-defibrillators. *Br Dent J* 2007; **203**: 577-579.
- Patient UK. Pacemakers and pacing. Last updated September 2014. Available online at www.patient.co.uk/doctor/Pacemakers-and-Pacing.htm# (accessed July 2015).
- College of Dental Hygienists Ontario. Clients with Cardiac Pacemakers. Available online at <http://www.cdho.org/reference/english/pacemaker.pdf> (accessed July 2015).
- Walmsley A D, Walsh T F, Burke F J T *et al.* Restorative dentistry. p 42. Churchill Livingstone, 2002.
- Miller C S, Leonelli F M, Latham E. Selective interference with pacemaker activity by electrical dental devices. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1998; **85**: 33-36.
- A Closer Look: Product Education at a glance. Dental equipment and implantable pacemakers and defibrillators. Boston Scientific, 2009. Available online at http://www.bostonscientific.com/content/dam/bostonscientific/quality/education-resources/english-a4/EN_ACL_Dental_Equipment_20090202.pdf (accessed July 2015).
- Foothill College. Foothill Global Access. 2.1 Cardiovascular drugs: dental implications. Available online at www.foothillglobalaccess.org/faculty/spragge/2_1_Cardiovascular/2_1_implications.html (accessed July 2015).
- Dentsply Professional. Cavitron SPS Ultrasonic Scaler with Steri-Mate Handpiece: Directions For Use. Available online at www.dentsply.com/DFU/eng/Cavitron_Jet_SPS_eng.pdf (accessed July 2015).
- College of Dental Hygienists of British Columbia. Interpretation guidelines. Implanted cardiac devices. p 38. June 2004, updated April 2015. Available online at <http://www.cdhibc.com/Documents/Interpretation-Guidelines-April-2015.aspx> (accessed 2015).
- Medicines and Healthcare products Regulatory Agency (MHRA) website. Available online at www.mhra.gov.uk/index.htm (accessed July 2015).
- Taktent. Managing dental health with cardiovascular issues. Available online at www.taktent.org.uk/articles/cardiovascular-issues.html (accessed July 2015).
- Bendit J. Magnets in dental chairs. 2010. Available online at www.dentistryiq.com/index/display/article-display/_saveArticle/articles/dentistryiq/hygiene-department/Magnets-in-dental-chairs.html (accessed July 2015).

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