

Using an Evidence-based Approach to Making Patient Recommendations for Power Toothbrushes



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Conflict of Interest Disclosure Statement

- Ms. Lesley Kupiec worked part-time as a dental hygiene educator for P&G and is a member of the P&G Oral Care Global Dental Hygiene Advisory Board. She has no relevant financial relationships to disclose.
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Introduction – Power Toothbrushes

Patients are more educated and asking more questions about their oral health. Dental professionals today can be overwhelmed by the number and variety of toothbrushes regularly surfacing on the market and the many differing technologies. All of these advances oblige dental professionals to seek information that will enable them to make the best product recommendations based on proven clinical effectiveness and gentleness, their own clinical experience, and patient preferences.

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Overview

Power or electric* toothbrushes are designed to facilitate the removal of bacterial plaque and food debris from the teeth and gingiva and to

reduce calculus and stain accumulation. With technology constantly improving, there are more options than ever for consumers when it comes to purchasing electric toothbrushes. Several distinct electric toothbrush technologies with differing modes of action are commercially available, and many offer compliance-enhancing features. The current generation of marketed power toothbrushes has been shown to be safe and efficacious. The trouble is that obtaining information today is easy, however growing misinformation creates mistrust and muddies the water between fact and fiction. Consequently, it continues to be necessary for dental professionals to know what products are currently available and keep up-to-date on what the science says in order to provide consumers with accurate information so that they can make the most appropriate evidence based decisions for their own health.

Learning Objectives

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

- Discuss the evolution of power/electric toothbrushes.
- Understand the different electric toothbrush technologies.
- Describe how different toothbrush technologies effect plaque, gingivitis, calculus and stain.
- Discuss the oral safety considerations of electric toothbrushes.
- Discuss evidence-based decision-making concepts and the hierarchy of evidence.
- Describe the basis for professional recommendation of electric toothbrushes.
- Summarize research presented on patient compliance with brushing recommendations.
- Identify instructional videos for different electric toothbrushes.

*The terms 'power' and 'electric' are used interchangeably. Early toothbrush models were referred to as electric. The use of the term 'electric' then transitioned to the term 'power.' The trend appears to be going back to the term electric. You will see both terms used in this course, depending on the referenced studies and published articles. Also, 'powered' toothbrush is sometimes used as the umbrella term for battery operated or electric toothbrushes.

Evolution of the Toothbrush

Manual Toothbrush Origins

Tooth cleaning devices date back thousands of years. Primitive configurations of the toothbrush - called “chewsticks” - are mentioned in Chinese literature as early as 600 B.C. The toothbrush in its more modern form finds its roots in 1498 A.D. China, when it was reportedly constructed of hog bristles. When toothbrushes began to surface in Europe in the late 18th and 19th centuries - often made of gold, ivory or ebony and with replaceable heads - their high cost prevented ownership by the masses. By the 1930s, however, affordable, plastic-handled, nylon filament manual toothbrushes had become widely available.^{1,2} While synthetic materials became the industry standard in toothbrushes until the 1970s, hard-bristled versions became popular as a result of a “brushing harder = cleaner teeth” mindset. This well-intended but misguided philosophy may have precipitated many cases of toothbrush abrasion to the teeth and gingiva as well as gingival recession of the surrounding tissues. Fortunately, softer, safer bristled models now prevail, and consumers have gotten the message that aggressive brushing is not recommended. Toothbrushing is now an integral part of the daily routine of most individuals in industrialized countries, who seek cosmetic and/or oral health benefits.³

The Road to Automation: Advances in Oscillating-Rotating (O-R) and Sonic Electric Toothbrush Technology

While manual toothbrushes have been the most commonly used mode of oral hygiene, the need for an even more effective alternative has been recognized for at least two centuries. The electric toothbrush as we know it today has its roots in the 1960s. These bulky electric brush forerunners were initially intended for special populations, e.g., those with limited dexterity. Their cumbersome size, unreliable power source, and a lack of concurrence regarding effectiveness all likely prevented broad adoption.⁴ Over the next few decades, electric toothbrushes were streamlined, and sophisticated toothbrush models with diverse designs and modes of action made their way to the marketplace. These second-generation

toothbrushes were no longer solely targeted for niche subgroups as the dental community increasingly came to appreciate the clinically observable benefits of the electric toothbrush for all population segments.

Oscillating-Rotating (O-R) Technology (Oral-B) Toothbrushes

Following extensive development, in 1978, Oral-B® (Procter & Gamble Company, Cincinnati, OH, USA) pioneered the first mass-produced electric toothbrush intended for general use. The “D-1” (Figure 1a) featured a manual-like brush head and a side-to-side motion. The following decade saw electric brushes with modes of action attempting to simulate the rotary, circular-like movements of professional cleaning instruments (e.g., Rotadent® [Zila, Fort Collins, CO, USA]) or utilizing varying brush head tufts rotating in a counter rotational fashion (e.g., Interplak® [Conair, East Winslow, NJ, USA]). As these were launched, the popularity of electric brushes for general use began to grow.

A major milestone occurred in 1991 with the introduction of the Oral-B Plaque Remover ‘D5’ and its novel, prophylaxis-inspired O-R mode of action (Figure 1b).⁵ With a cup-shaped brush head and end-rounded bristles providing robust plaque removal via 5600 oscillations per minute, this was the first electric toothbrush technology clinically proven to clean better than a manual toothbrush.⁶ It also featured new compliance-enhancing features, including a two-minute light timer to boost brushing frequency.

Oral-B Plaque Remover ‘D5’ - 1991

O-R mode of action.

First electric toothbrush clinically proven to clean better than a manual toothbrush.

Two-minute light timer.

The next few years brought additional technological advances in O-R technology. The Oral-B 3D Plaque Remover (later renamed the ‘D15’) debuted in 1998, incorporating high frequency pulsating movement to the oscillating-rotating technology (O/R/P) for three-dimensional brush head movement, providing



Figure 1a. Oral-B 'D1'.



Figure 1b. Oral-B 'D5' and its novel, prophylaxis-inspired oscillating-rotating (O-R) mode of action.



Figure 1c. Oral-B 3D Plaque Remover (later renamed the 'D15').

enhanced plaque removal and penetration in the approximal regions (Figure 1c).⁷

Adding increased oscillations and pulsating frequencies later culminated in the Oral-B Professional Care Smart Series with SmartGuide™ power toothbrushes. The Oral-B Triumph with Smart Guide (Figure 1d), launched in 2007, was the first power toothbrush with clinically proven combined O/R/P technology, together with an innovative new wireless remote display feature (Smart Guide) for continuous visible brushing feedback.⁸

Oral-B Triumph with Smart Guide - 2007

First electric toothbrush with clinically proven combined O/R/P technology. Wireless remote display feature (Smart Guide) for continuous visible brushing feedback.

In 2014, Oral-B introduced The Oral-B PRO 5000 with Bluetooth 4.0 connectivity (Figure 1e). It was the world's first Bluetooth connected power toothbrush, which allowed for two-way communication between the brush and the Oral-B app to enable real time feedback, motivation, and rewards as well as a more

personalized brushing routine. The app feature allowed patients to work hand-in-hand with their dental professional, who could program a patient's brushing routine to help improve brushing behaviors and focus on problem zones within the mouth. This technology gave patients greater control over their oral care practices.

The Oral-B PRO 5000 - 2014

World's first Bluetooth connected power toothbrush.
Real time feedback, motivation, and rewards.
More personalized brushing routine.

Two years later, Oral-B unveiled its next innovation, the Oral-B GENIUS (Figure 1f). The Oral-B GENIUS featured groundbreaking Position Detection Technology that combined motion sensor technology and video recognition using a smartphone's camera to track areas being brushed. Users received instant feedback on the brushing of each zone of the mouth so that no zone was missed. The Oral-B App also included guidance on whether too much pressure was applied and brushing duration.



Figure 1d. Oral-B Triumph with wireless Smart Guide.



Figure 1e. Oral-B PRO 5000 with Bluetooth 4.0 connectivity.



Figure 1f. Oral-B GENIUS.

Oral-B GENIUS - 2016

Position Detection Technology combines motion sensor technology and video recognition. Receive instant feedback on the brushing of each zone. Guidance on too much pressure and brushing duration.

The next generation of O-R technology introduced by Oral-B in 2020 is the Oral-B iO electric toothbrush (Figure 2).⁹ This new O-R brush represents a comprehensive internal and external re-design. It has been developed with a linear magnetic drive resulting in oscillating-rotations with micro-vibrations from controlled energy being directed to the bristle tips. This also provides a smoother brushing experience. The brush heads have been redesigned with features such as new tuft-in-tuft bristle trims and high-density bristle fields to maximize tooth surface coverage and cleaning, allowing bristles to penetrate along the gingival margin and proximally. It also has a 'smart' pressure sensor which not only lets users know when they are applying too much pressure, but unlike other power toothbrushes, it lets the user know when the pressure is too little or in the optimal range for safe and effective plaque removal.¹⁰ Also, if too much pressure is applied, the electronically

controlled linear magnetic drive automatically decreases the brush speed so that it operates in the Sensitive mode.

Oral-B iO Electric Toothbrush - 2020

Internal and external re-design. Developed with a linear magnetic drive = O-R with micro-vibrations. Smoother brushing experience. 'Smart' pressure sensor - indicates excessive pressure, insufficient pressure and optimal pressure range.



Figure 2. Oral-B iO Electric Toothbrush.



Figure 3a. Sonicare Elite.



Figure 3b. Sonicare Flexcare Platinum.



Figure 3c. Sonicare Flexcare Platinum Connected.

Sonic Technology (Philips Sonicare and Others) Toothbrushes

A side-to-side motion undergirded by a high frequency (“sonic”) power toothbrush technology was introduced in 1992 (Sonicare® [Philips Oral Healthcare, Snoqualmie, WA, USA]) and later called Advance™. Sonic power toothbrushes also have continued to evolve since their debut. A second-generation Philips sonic brush - Sonicare Elite™ - was marketed in 2002 (Figure 3a); it was differentiated from the original sonic brush by a modified bristle trim, slim/angled brush head shaft to target hard-to-reach regions, and modified lighter and smaller brush handle.¹¹

Sonicare, high frequency (“sonic”) power toothbrush - 1992

Sonicare Elite™ - 2002

Modified bristle trim, slim/angled brush.
Modified lighter and smaller brush handle.

In 2013, Phillips introduced the Sonicare FlexCare Platinum with the InterCare brush head (Figure 3b). The FlexCare Platinum featured 3 modes with 3 levels of intensity offering 9 different brushing experiences. In addition, the handle was equipped with a pressure sensor to alert individuals when too much pressure was applied to hard or soft tissue. The FlexCare Platinum also featured an ultraviolet sanitizer to disinfect brush heads after use.

Sonicare FlexCare Platinum with the InterCare brushhead - 2013

3 modes with 3 levels of intensity offering 9 different brushing experiences.
Handle equipped with a pressure sensor too much pressure.
Ultraviolet sanitizer to disinfect brush heads.

In 2016, Phillips introduced the FlexCare Platinum Connected in which it incorporated Bluetooth technology into the handle (Figure 3c). The FlexCare Platinum Connected features Smart Sensor technology which tracks patients’ brushing in real time and syncs via Bluetooth technology with the free Philips Sonicare app. This feature allows one to create a personalized 3-D Mouth Map, helping users identify missed trouble spots and guiding them to proper brushing technique. The Smart Sensor technology provides feedback to help patients effectively reach more surfaces each time they brush.

Sonicare FlexCare Platinum Connected - 2016

Bluetooth technology into the handle.
Smart Sensor technology to tracks patients’ brushing in real time.
Syncs via Bluetooth technology with Philips Sonicare app.
Provides feedback to help patients effectively reach more surfaces.



Figure 3d. Sonicare DiamondClean Smart.



Figure 3e. Sonicare ProtectiveClean 5100.



Figure 4. WaterPik Sonic-Fusion® device.

Source: [Water Pik](#)

More recently, the ProtectiveClean, DiamondClean and DiamondClean Smart power toothbrushes are now available, with the DiamondClean Smart electric toothbrush being the top of the line model (Figure 3d). It is equipped with up to 5 built-in smart sensors and a connected app to guide brushing. Settings are included for gum health, plaque removal, and whitening. Sonicare smart brushes deliver up to 62,000 brush movements per minute, giving the equivalent results of a whole month's worth of manual brushing in just two minutes.

BrushSync technology is a feature of the Sonicare ProtectiveClean model which lets users know how hard they have been brushing and when it is time to replace the brush head. In certain models, BrushSync will automatically reorder and send users new brush heads once set up through the Philips Sonicare connected app.

ProtectiveClean, DiamondClean™ and DiamondClean Smart (top of the line model)

DiamondClean Smart equipped with 5 build-in smart sensors and a connected app.

Gum health, plaque removal, and whitening settings.

BrushSync technology - feature of Sonicare ProtectiveClean.

Other sonic brushes also are on the market and widely available. One of the most notable is Quip. It is relatively inexpensive and was the first to actively market a subscription brush head re-ordering program, which others are now offering. Similar to Quip is the electric toothbrush by the smile™ Direct Club. Consumers will also see other sonic and O-R power toothbrushes, many of which have a store brand identified on it, e.g., Kroger Smile Sonic® Pro or CVS Health Infinity Rechargeable Toothbrush.

Another new entry to the marketplace is the WaterPik Sonic-Fusion® device, which combines the Waterpik® Water Flosser and a Sonic-Fusion® power toothbrush (Figure 4). This allows the user to brush and/or water floss using a single device. The sonic toothbrush uses a back-and-forth motion and is designed to clean both supra-and subgingival areas. "With the click of a button, the brush head becomes a jet tip for water flossing," using the same hydrodynamic action used in all other Waterpik models.¹²

Differences in Power Toothbrush Technologies, Benefits and Research Support

Contrasting today's myriad power toothbrush options with the few available in the early days of electric brush technology highlights the dramatic technical innovation seen in the last half of the century. Dental professionals and patients now have numerous choices

when recommending or selecting an electric toothbrush, and understanding the technology, benefits, and clinical research support of the various technologies is foundational to making a wise selection. In addition to research, the power source, cleaning technology modality, and brush head options are three variables distinguishing commercially available electric toothbrushes.

Power Source

Power toothbrushes are marketed today in one of two ways: 1) disposable and battery-operated; or 2) rechargeable electric source.

1. Disposable and Battery-powered Toothbrushes

Lower cost, replaceable (disposable), battery-operated toothbrushes utilize built-in AA batteries so that the batteries can be replaced when worn down (on some models) or the entire toothbrush discarded. On other models, the brush head can be replaced. As the battery life is reduced, the toothbrush speed also reduces. These brushes may be valued by those seeking a budget-friendly power brush option, or by those who want to test the waters with power toothbrushes with a minimal cost investment. Typically, they do not have innovative features such as speed, pressure control, or Bluetooth connectivity, however, depending on the type of technology, still may be more effective than a manual toothbrush in reducing plaque and gingivitis.

2. Rechargeable Electric Toothbrushes

Powered toothbrushes with rechargeable batteries are charged by sitting on a stand that is connected to an electrical outlet or USB port. Advances in technology have also introduced travel cases with the ability to charge the electric toothbrush. Users keep the handle and replace the brush head optimally every three months or sooner if they see the bristles have been splayed (spread out/bent/distorted). The speed of these brushes varies from low to high, with the variance dependent on the manufacturer and type of brush. Rechargeable brushes typically are equipped with the most features, varying in cost based on the extent of high-tech

options to monitor safety, brushing time, and ensure the best brushing experience.

Cleaning Technology Modalities

In addition to their power source, power toothbrushes differ in their cleaning technology mechanisms and can be categorized by the manner in which the brush head moves. Table 1 summarizes the various types of motion and modes of action in electric brush movements.

Brush Heads

Today's advanced brush technologies are definitely not "one size fits all." Because patients have individual oral hygiene needs, some manufacturers offer multiple brush head options, including round, conical, or manual-like heads for targeted cleaning and/or patient preference.

For example, the Oral-B brush head is round, similar to a professional's rubber cup used for polishing. Its size, shape and angle allow it to adapt to each tooth surface by cupping the tooth and allowing patients to clean difficult-to-reach surfaces. In addition to soft end-rounded bristles, each brush head has unique features designed to address specific patient needs. Indicator™ bristles signal when patients should replace their brush head for optimal plaque removal and safety. A variety of interchangeable brush heads for different patient needs are available for adults, children, and orthodontic patients as well as for interdental spaces (Figure 5a).

Currently replacement brush heads for Oral-B are compatible across all of their power toothbrush series (GENIUS, Smart, PRO/Vitality) with the exception of Oral-B iO, which have different brush heads (figure 5b) as part of the complete internal and external redesign (including the new linear magnetic drive) that this next-generation oscillating rotating toothbrush represents. The round brush heads for the Oral-B iO also represents a complete redesign, including the 'Tuft-in-Tuft' feature for plaque removal in hard to reach areas. Slight twisting of tufts allows for adaptability on tooth surfaces for an optimal clean. (Figure 5c).⁹

Table 1. Comparison of Power Toothbrush Technologies.

Mode of Action	Brush Head Motion	Examples
Oscillating-Rotating	Brush head rotates in one direction and then the other. Does not rotate in full circle.	Oral-B Vitality
Oscillating-Rotating Pulsating	Entire brush head oscillates, rotates, and pulsates.	Oral-B Professional Care Series Oral-B Smart Series Oral-B GENIUS
Oscillating-Rotating with Micro-vibrations	Brush head oscillation rotation is synchronized with micro-vibrations, a novel, bristle-driven, vertical movement.	Oral-B iO
Side-to-side (sonic)	Brush head moves laterally in a side-to-side motion.	Philips Sonicare
Multi-directional	Brush sweeps from side-to-side and pulsates.	Colgate ProClinical
Counter-Oscillation	Adjacent tufts rotate in opposite directions to each other.	InterplakD
Circular/Rotary	Entire brush head rotates in a full circle moving in one direction only.	Rotadent® Rotadent.com Den-Mat Holdings, LLC©2018
Ultrasonic	Uses a very high frequency of vibration to remove plaque and bacteria from the teeth. Does not need physical motion. Bristles vibrate at ultrasonic frequencies of 1.6MHz or 192,000,000 movements per minute	Megasonex or Emmi-Dent Toothbrushes
Ionic	Similar to a manual toothbrush. Maintain contact with the metal band on the brush which imparts an electrical charge to the tooth's surface.	IONICKISS Dyna-Dental Systems

Figure 5a. Variety of Oral-B Interchangeable Brush Heads.



Oral-B CrossAction Brush Head



Oral-B FlossAction Brush Head



Oral-B 3D White Brush Head



Oral-B Precision Clean Brush Head



Oral-B Sensitive Clean Brush Head



Oral-B Ortho Brush Head



Oral-B Interproximal Clean Brush Head



Figure 5b. Oral-B iO Brush Heads (Left to Right) Ultimate Clean, Gentle Care, Targeted Clean.

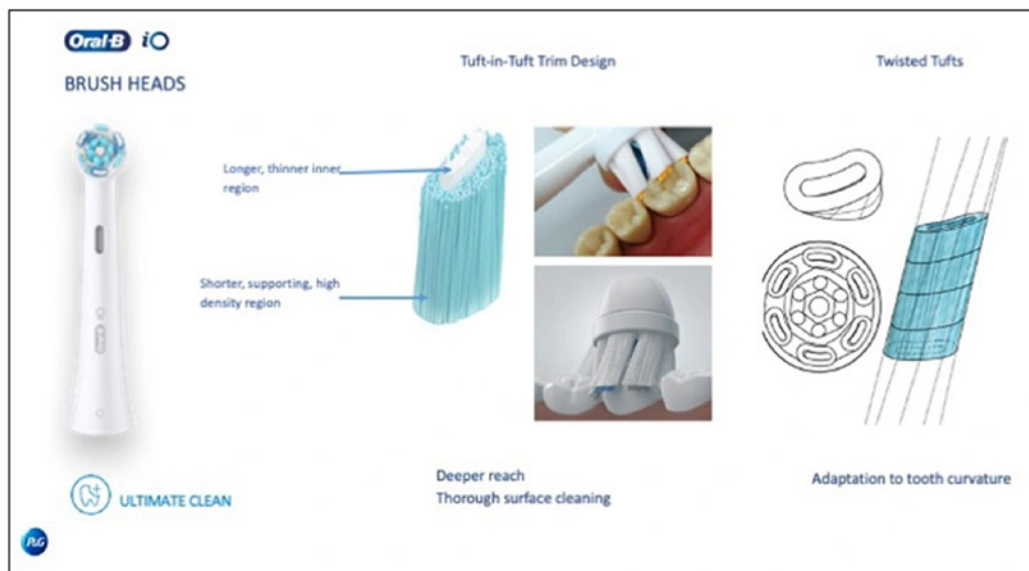


Figure 5c. Oral-B iO Ultimate Clean brush head design.

In contrast, sonic brush heads closely resemble that of a manual toothbrush, which some patients favor (Figure 6). Unlike Oral-B, the leading sonic toothbrush manufacturer states that its single brush head can be used for multiple patients' needs. For example, directions are provided for those with braces. (See Box).

Philips Sonicare Instructions on How to Brush Your Teeth Wearing Braces

1. Wet the bristles of the brush head.
2. Apply a small amount of toothpaste.
3. Place the bristles against your teeth at a 45° angle.
4. Press the power button to start brushing.
5. First, brush above the brackets. Then below the brackets.
6. Finally, clean between your braces with a circular motion.

Please do not force the bristles into the gaps of your braces.

Source: Phillips Sonicare

Safety Features of Power Toothbrushes

Several rechargeable electric toothbrush models offer pressure sensors to monitor the force being applied by the user when brushing. Pressure sensors alter the brush movement to make patients aware when too much pressure is being applied. Many electric toothbrushes are equipped with a light which illuminates when too much pressure is applied (Figure 7a). The new Oral-B iO power toothbrush is the first to have a smart pressure sensor that also indicates when the user is not applying enough pressure and when the user is in the optimal pressure range for plaque removal and safety (Figure 7b). And, if too much pressure is being applied, the electronically controlled linear magnetic drive automatically reduces the oscillation angle to operate in the 'sensitive' mode.⁹

Brush filaments are made of soft end-rounded nylon in various diameters. Endrounding occurs during the manufacturing process after the bristles are inserted into the brush head. The bristles are sanded and then polished to a smooth rounded tip. A bristle's stiffness is directly related to its diameter and length: thicker bristles require more force to bend

Figure 6a. Variety of Sonic Brush Heads.





Figure 7a. Pressure sensor light illumination – too much pressure.



Figure 7b. Pressure sensor light illumination – correct pressure.

than thinner bristles. Soft bristles are preferred because hard bristles may abrade the gingiva. Now, most manufacturers use endrounding technology to ensure safety for both hard and soft tissues in the oral cavity.

Evidenced-based Decision Making (EBDM): Concepts in Understanding the Research and Helping Patients Make Smart Decisions

EBDM Basic Concepts

In order to use an evidence-based approach, understanding evidence-based concepts involves knowing the design of different research methods.

EBDM is comprised of 4 elements: clinical expertise, patient preferences, clinical circumstances and the scientific evidence. EBDM is a tool to improve the quality of care and to reduce the gap between what we know and what we do. EBDM is about solving clinical problems. In solving these problems, a hierarchy of evidence is available to guide clinical decision-making and as a hierarchy implies, not all evidence is equally useful for making patient care decisions.

As you progress up the hierarchy, the research designs allow more control so that intervention or treatment outcome differences are not due to chance. Also, as you progress up the hierarchy, the number of published studies decreases, and yet these are more clinically relevant studies. Therefore, to answer your

question, you should search for studies at the top of the hierarchy, (e.g., Practice Guidelines, Meta-analyses, Systematic Reviews, and then RCTs).^{**}

Search for studies at the top of the hierarchy:

Practice Guidelines
Meta-analyses
Systematic Reviews
Randomized Controlled Trials

There are two categories of evidence sources: Primary and Secondary research studies (Figure 8). Primary research is the original, individual study. The highest level of primary research is an individual randomized controlled trial (RCT), Level 1. Primary studies involve participants that undergo an intervention or receive a treatment in order to evaluate its impact and are the most complex to conduct. RCTs provide the strongest evidence for demonstrating cause and effect, i.e., the treatment (e.g., type of electric toothbrush) has caused the effect (decrease in gingivitis), rather than it happening by chance.

Secondary research is a synthesis of primary research studies that have studied the same topic, e.g., Systematic Reviews (SRs) (Figure 9). This scientific technique defines a specific question to be answered and uses explicit pre-defined criteria for retrieval of studies. An example of a specific question is, “For adult patients with heavy plaque, will electric toothbrush A, as compared to electric toothbrush B, be more effective in decreasing the amount of plaque over a 3-month period?”

Methods used in SRs parallel those of RCTs in that they follow rigorous procedures and each step should be thoroughly documented and reproducible. For example, where individual RCTs have predefined criteria for the inclusion and exclusion of subjects, SRs have predefined criteria for the inclusion and exclusion of research studies. A SR with a Meta-Analysis, often referred to as just a meta-analysis (MA), combines the data from similar individual studies and conducts an analysis of this pooled data.

Systematic reviews and MAs serve as the basis for formulating Clinical Practice Guidelines (CPGs), which sit at the top of the hierarchy. One of the challenges of the evidence-based process is interpreting the research and appraising the results, a CPG does just that. It is not a research design, but the interpretation of the research so that it can be applied to patient care. Although SRs and MAs are higher

levels of evidence, the systematic reviews are only as good as the individual studies that are included, therefore, not all are created equal.

Where do you Find the Scientific Evidence?

PubMed

Finding relevant evidence to answer clinical questions requires conducting a focused

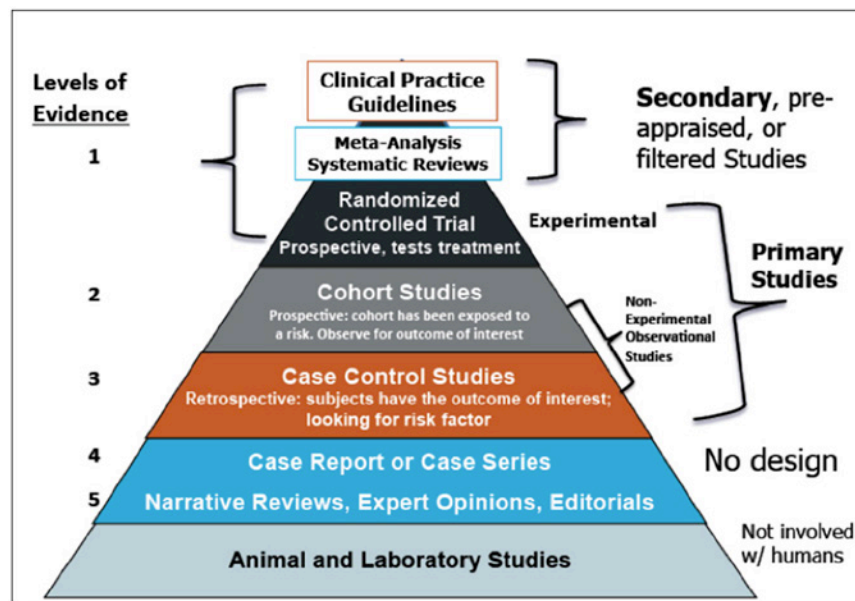


Figure 8. Hierarchy of Evidence.

Categories of Research Designs: Primary and Secondary research studies and how they relate to the hierarchy of evidence.

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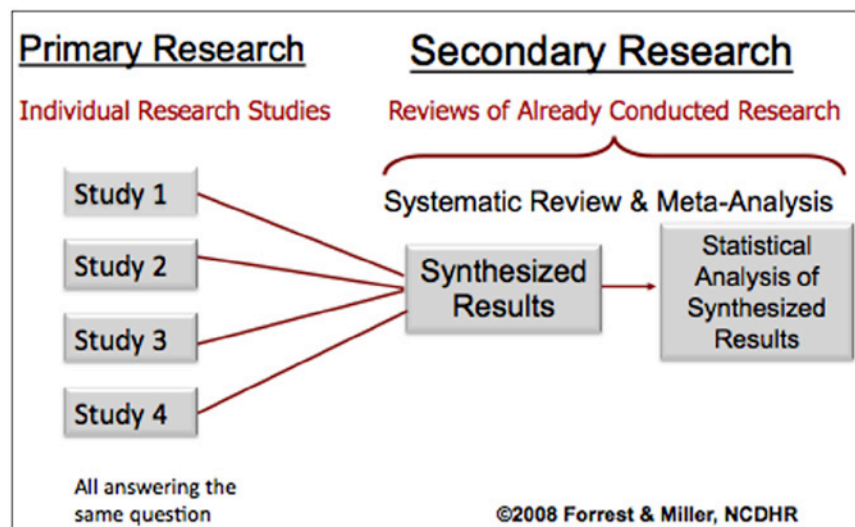


Figure 9. Relationship between Primary and Secondary Research.

Summary of Relationship between Primary and Secondary Research.

Source: [DHNET. Research & Topics](#)

search of the peer-reviewed professional literature. To assist professionals in keeping up with the literature and in making it possible to quickly find needed information without leaving your location, online access to MEDLINE, the premier and largest scientific database, is available at no cost through PubMed. Searching PubMed allows you to search through thousands of journals at the same time, thus you are not limited to a journal to which you may have a subscription. It also allows you to search and organize articles by level of evidence. For further information on this subject, please view the peer-reviewed CE course [Strategies for Searching the Literature Using PubMed \(CE340\)](#).

Some of the preferred dentally related journals indexed in PubMed include: *American Journal of Dentistry*, *The Journal of Clinical Dentistry*, *Evidence Based Dentistry*, *The Journal of Evidence-Based Dental Practice*, *Journal of Clinical Periodontology*, *Journal of the American Dental Association*, *Journal of Dental Hygiene*, *International Journal of Dental Hygiene*, the *Dental Assistant Journal* and the journals of the different specialty associations. Table 2 provides a listing of evidence information sources.

Independent Organizations

Another source of research evidence is independent organizations such as the [Cochrane Collaboration](#). Their number one goal is, "To produce high-quality, relevant, up-to-date systematic reviews and other synthesized research evidence to inform health decision making."

Each Cochrane Review addresses a clearly formulated question, searches all the existing primary research on a topic that meets certain criteria; then assesses it using stringent guidelines, to establish whether or not there is conclusive evidence about a specific treatment. Cochrane Reviews are internationally recognized as the highest standard in evidence-based health care and reviews are published online in the Cochrane Library. Cochrane Reviews should be updated regularly to incorporate new research, so that treatment decisions can be based on the most up-to-date

and reliable [health evidence](#). Published Cochrane reviews and critical summaries of those reviews that have been published in journals indexed by PubMed can be found through searching PubMed. However, do not assume if it isn't in PubMed it doesn't exist – search the Cochrane website.

Other Resources

The internet contains a wealth of information for dental professionals and patients, yet much of it may be inaccurate and biased so caution is warranted in verifying its accuracy, and source-checking is recommended. Conducting a Google search may identify a wide range of citations. Unfortunately, you will not know if they take you to a research article on PubMed or represent an individual's personal opinion (the lowest level of evidence) until you click on them. Again, caution is advised. Ultimately, the dental professional must evaluate the information, and if accurate and relevant, apply it and evaluate the outcome. The internet also offers many resources for consumer information on products or links to product information, however, finding research that supports the products can be very difficult. For example, Quip offers no research and SmileDirect cites previous research on manual vs. power toothbrushes, some of which does not directly support the use of sonic technology.¹³

ADA Seal of Acceptance

Another characteristic that many consider important in making recommendations is if the product has the ADA Seal of Approval. Keep in mind the ADA Seal Program is voluntary.

As per a [2017 national survey of consumers](#), the results indicated that 2 out of 3 consumers reported the ADA Seal on a product simplifies their purchasing decision, 71% would choose a Seal product over a similar product without a Seal, and 69% say they would pay more for a product that displays the ADA Seal. The Seal represents a symbol of safety and efficacy, and it takes the guesswork out of purchasing.

To [obtain the ADA Seal of Acceptance](#) for a power toothbrush, certain criteria must be met. A company must submit safety testing certifications, provide claims of safety and

Table 2. Evidence Information Sources.

SYSTEMS: Clinical Decision Support Systems: Interactive Drug Databases

Lexicomp - Evidence-Based Drug Referential Content	lexicomp.com: https://www.wolterskluwer.com/en/solutions/lexicomp
Natural Standard – Integrative Medicine with EB Grading system	naturalstandard.com

GUIDELINES

American Academy of Pediatric Dentistry (AAPD)	https://www.aapd.org/research/oral-health-policies--recommendations/
American Academy of Periodontology	https://www.perio.org/research-science/aap-clinical-and-scientific-papers/
ADA Clinical Recommendations, Science & Research Institute (ADASRI)	https://www.ada.org/resources/research/science-and-research-institute/oral-health-topics
ADHA, Position Papers and Consensus Statements	adha.org
American Heart Association	https://www.heart.org/en/health-topics/infective-endocarditis
Centers for Disease Control and Prevention	cdc.gov/OralHealth/index.html
PubMed (Filter to Practice Guideline)	pubmed.gov
Scottish Intercollegiate Guidelines Network	sign.ac.uk
Canadian Dental Association	cda-adc.ca/en/about/position_statements
Canadian Dental Hygiene Association	cdha.ca (click on Professions tab, then Research)

SYNOPSIS OF SYSTEMATIC REVIEWS (CRITICAL SUMMARIES)

ADA Science & Research Institute, Oral Health Topics	ada.org/sri
PubMed (Look for Comment in under the abstract)	pubmed.gov
Evidence Based Dentistry Journal	nature.com/ebd
Journal of Evidence-Based Dental Practice	jebdp.com
Trip Database	tripdatabase.com

SYSTEMATIC REVIEWS

ADA Science & Research Institute, Oral Health Topics	ada.org/sri
Cochrane Database of Systematic Reviews	cochranelibrary.com
PubMed (Filter to Systematic Reviews)	pubmed.gov
Evidence Based Dentistry journal	nature.com/ebd
Journal of Evidence-Based Dental Practice	jebdp.com
Trip Database	tripdatabase.com

SYNOPSIS OF INDIVIDUAL STUDIES

PubMed (Look for Comment in under the abstract)	pubmed.gov
Evidence Based Dentistry	nature.com/ebd
Journal of Evidence-Based Dental Practice	jebdp.com

ORIGINAL STUDIES

PubMed	pubmed.gov
Journal Publications	access association & publisher websites

efficacy, and instructions for use. A safety standard, the American National Standards Institute (ANSI)/ADA standard No 120, must also be satisfied for approval. Although not mandatory, clinical studies may be provided for consideration.

The ADA Seal program makes it easy to search for different products. Go to their [website](#), select the product category, and click on it (Figure 10).

Product category

<input type="checkbox"/>	Athletic Mouthguards	3
<input type="checkbox"/>	Denture Adherents	2
<input type="checkbox"/>	Denture Cleansers	5
<input type="checkbox"/>	Drinking Water Filters	2
<input type="checkbox"/>	Dry Mouth Relief	1
<input type="checkbox"/>	Emergency Tooth Preservation	1
<input type="checkbox"/>	Enamel Erosion Control	5
<input type="checkbox"/>	Floss/Manual Interdental Cleaners	14
<input type="checkbox"/>	Fluoride Mouthrinses	33
<input type="checkbox"/>	Fluoride Toothpastes	51
<input type="checkbox"/>	Manual Toothbrushes	15
<input type="checkbox"/>	Oral Discomfort Relief	3
<input type="checkbox"/>	Oral Malodor Control	5
<input type="checkbox"/>	Plaque/Gingivitis Control	33
<input type="checkbox"/>	Powered Interdental Cleaners or Oral Irrigators	5
<input checked="" type="checkbox"/>	Powered Toothbrushes	19
<input type="checkbox"/>	Sensitivity Control	10
<input type="checkbox"/>	Stain Removal	3
<input type="checkbox"/>	Sugar Free Chewing Gums	8
<input type="checkbox"/>	Tooth Bleaching Products	3

Figure 10. ADA Seal Product Search.

In our case, we want information on power toothbrushes so click on "Powered Toothbrushes (Figure 11).

Also, clicking on the toothbrush name provides you with more information and identifies the brushes that have been accepted. All products within the power toothbrush category have the following statement: "The ADA Council on Scientific Affairs' Acceptance of _____ is based on its finding that the product is safe and has shown efficacy in removing plaque and helping to prevent and reduce gingivitis, when used as directed."

Unlike the approval for powered toothbrushes, the Waterpik® Sonic-Fusion® Toothbrush/Flosser received the ADA Seal of Acceptance in the Powered Interdental Cleaners category, not Toothbrush-Powered category. As per the ADA Seal statement, "The ADA Council on Scientific Affairs' Acceptance of [Waterpik Sonic-Fusion Toothbrush/Flosser](#) is based on its finding that the product is safe and has shown efficacy for removing plaque along the gumline and between teeth and helping to prevent or reduce gingivitis, when used as directed." This statement is provided for all the products that have been accepted in this category.

What is the Evidence?

Clinical Efficacy Evidence: Reducing Plaque, Gingivitis, Staining and Calculus

While patient preference is an important factor in toothbrush selection, equally integral is the ability of a given toothbrush – manual or power – to improve oral health through efficient plaque biofilm removal and reduce signs of gum disease such as inflammation and gingival bleeding. Many patients are also interested in a brush's capacity to target cosmetic concerns, such as stain removal and whitening, and unsightly supragingival calculus.

Many factors, such as family predisposition, smoking habits, systemic disease and host defense mechanisms, determine how patients respond to the bacterial plaque existing in their oral cavities. Dental professionals cannot control or change most of these risk factors; therefore, the focus should be

Table 3. Summary of Electric Toothbrush Features – Most Recent Models.

Company	Brush/Series Name/Year	Features	ADA Seal of Approval*	Mode of Action	Apps
P&G	Oral-B iO™ Series 2023	Linear magnetic drive; Smart pressure sensor (alerting pressure both too hard and just right) Smart display-real time personalized coaching. Up to 7 Brushing Modes; 3D Teeth Tracking and AI Brushing Recognition; Bluetooth; Magnetic charger; 2 brush heads Power2Go Charging Travel Case	Yes	Oscillating- Rotation + Micro- vibrations	
P&G	Oral-B Genius Series 2016	Pressure Sensor; Position detection; 360 SmartRing; 2-minute brushing timer; 5-6 Brushing Modes; Position detection; AI Smart Coaching; Bluetooth; USB Charging Case; 6 Brush heads available; 2 specialty heads; 3 brush heads with subscription refill options	Yes	Oscillating- Rotating- Pulsating	
WaterPik®	Sonic-Fusion 2019	3 modes, Brush becomes a jet tip for water flossing; 2-minute timer, 30 second pacer; Advanced pressure control; Recharge indicator light; Premium toothbrush case	Yes	Sonic/Water Flosser	None
Philips Sonicare	Diamond Clean Smart 2017	4-5 different modes, 3 intensities; 3 premium brush heads; 4 colors; Stylish glass charger and premium travel case with USB charger; Bluetooth; Smart Sensor Technology	No	Sonic	
Philips Sonicare	Protective Clean 2018	Subscription of handles and brush heads available; 1-3 different modes, 3 intensities; Built-in pressure sensor; 1 brush head; BrushSync features; Travel case	Yes	Sonic	
Quip	Quip 2015	Starter Kit; Refill Plans including brush heads, toothpaste, floss; - minute timer; Suction Mirror Mount/Travel Cover; AAA battery	Yes	Sonic Vibrations	None

the abilities of various brush technologies. With the revision of the American Academy of Periodontology (AAP) and European Federation of Periodontology (EFP) criteria in 2017 several unresolved issues with the previous 1999 periodontal classification were addressed by identifying the difference between presence of gingival inflammation at one or more sites and the definition of a gingivitis case. For the first time, the 2017 classification system defines clinical health and gives clear definitions of periodontal health and gingivitis.^{17,18}

It is agreed that bleeding on probing should be the primary parameter to set thresholds for gingivitis. As such, 10% of sites is the threshold for health/non-health. So, gingivitis studies conducted after the acceptance of the new classification system should be using the 10% threshold and addressing the odds of patients transitioning from gingival bleeding and disease to health.^{18,19}

Unfortunately, research has shown that many individuals do not achieve thorough plaque removal solely with use of a manual toothbrush and do not floss regularly, whether due to lack of ability or motivation.²⁰⁻²² More recent research emphasizes the use of interdental brushes (IDB), which have been shown to be more effective plaque removal devices than string floss.^{14,15} Conversely, electric toothbrushes with built in smart technology with timers can motivate patients to brush more regularly and for longer durations.^{8,23,24}

Also, because a skilled brushing technique is less critical as the electric brush does the work, plaque removal (both overall and proximally) can be greater with use of certain power toothbrushes and with the use of a water flosser.²⁵

Plaque and Gingivitis Control

One reason first generation electric toothbrushes were not widely promoted beyond special needs and orthodontic populations in the 1960s and 1970s was a lack of evidence that they provided equivalent or superior plaque control to a standard manual toothbrush. Keep in mind, O-R and sonic power brushes were not launched

until the late 1980s-early 1990s. It was during the 1998 European Workshop on Mechanical Plaque Control, Dr. G.A. van der Weijden, (ACTA, Amsterdam), concluded, It was reported during the 1998 European Workshop on Mechanical Plaque Control that using electric toothbrushes appear to be superior to using manual brushes.²⁶

With new power toothbrush models debuting frequently, dental professionals may wonder how to best assess the effectiveness and safety of them since all brushes do not perform equally well. Ideally, toothbrush claims should be supported by well-controlled clinical research. The following table provides a summary of research findings related to plaque and gingivitis control comparing different electric technologies and manual toothbrushes. The RCTs represent individual studies whereas, the Systematic Review represent multiple studies on the same topic.

Overall, research findings demonstrate that the O-R and sonic brushes are significantly more effective in reducing plaque and gingivitis than a manual toothbrush; and, the majority of RCTs and Systematic Reviews with a Meta-analysis report the O-R technology is more effective than sonic technology. Additionally, the most advanced O-R models offer enhanced efficacy versus traditional O-R models.⁷²

Stain Removal/Whitening and Calculus

Studies have shown power toothbrushes remove extrinsic stains caused by coffee, tea and tobacco better than manual brushing and thus promote tooth whitening, a feature particularly important to many patients. Terézhalmy et al. studied the impact of using an O-R power toothbrush with study participants with existing stain and compared it with a dental prophylaxis followed by brushing using a manual toothbrush. After two weeks, the power toothbrush produced effective stain removal (>90%) comparable to that of the oral prophylaxis with manual toothbrushing.⁴⁰ These investigators subsequently evaluated the stain-removing capabilities of two sonic toothbrushes in subjects with pre-existing stain, and found both brushes to provide highly statistically significant reductions in stain following two weeks of twice daily use.⁴¹

Clinical research also has shown that an O-R power toothbrush can control dental calculus formation. In a crossover trial comparing a manual toothbrush, a sonic power toothbrush, and the Braun Oral-B 3D Excel, the Oral-B O-R brush was the most efficacious, yielding a 63% reduction in calculus from baseline.⁴²

Clinical Evidence of Gentleness/Safety

Tooth wear is becoming a greater issue as life expectancy is increasing and teeth are retained in the oral cavity longer.⁴³ Exposed dentin as a result of receding gums is not esthetically pleasant but may also lead to sensitivity and root caries. The propensity of a given toothbrush and/or brushing technique to contribute to abrasion and gingival recession is therefore a concern.

Abrasion and Recession

Tooth and gingival abrasion are defined as pathologic wear as a result of a foreign substance (Figure 12). Abrasion is multi-factorial but is generally believed to be caused by improper brushing technique, frequent brushing with too much pressure, bristle design or stiffness, dominant hand dexterity, or abrasiveness of toothpastes.⁴

Gingival recession is defined as the reduction of the height of the marginal gingiva to a location apical to the cemento-enamel junction, resulting in root surface exposure (Figure 13). Gingival recession can also be precipitated by many factors including increasing age, gender, and anatomical factors. Improper occlusal load from the force generated by clenching and

Table 4. Summary of Research Studies (RCTs & Systematic Review) on Plaque and Gingivitis.

Source/Study Author Year & Reference	# Studies/Subjects	Outcome/Conclusions Summary
Robinson PG et al. Cochrane Systematic Review; Power vs. manual brush, 2005. ⁶	42 Studies; Included a total of 4,000 subjects	Only power toothbrushes which employed a rotation-oscillation action were proven consistently superior at removing plaque and reducing gingivitis more effectively than manual brushes in the short and long-term.
Biesbrock AR et al. (P&G); RCT; oscillating-rotating vs. sonic toothbrush; plaque removal efficacy and safety, 2008. ²⁷	45 Subjects	Both brushes were found to be safe and significantly reduced plaque after a single brushing. Oral-B Triumph was significantly more effective in plaque removal than Sonicare (P < 0.0001). Compared to Sonicare FlexCare, the adjusted mean plaque reduction scores for Oral-B Triumph were 21%, 23% and 22% greater for whole mouth, marginal and interproximal areas, respectively.
Deacon SA et al. Cochrane, Systematic Review of Different Powered TBs for Plaque & Gingivitis, 2010. ²⁸	17 Studies; Included 1369 subjects, 4 weeks up to 3 months; 7 trials up to 3 months at least	Some evidence that rotation-oscillation power toothbrushes reduced plaque and gingivitis more than side-to-side (sonic) power brushes in the short-term. The difference is small, and its clinical importance is unclear.
Klukowska M, et al. (P&G); RCT; Oscillating-rotating toothbrush vs. standard manual brush 2010. ²⁹	118 subjects; 4 weeks	O-R electric toothbrush yielded significantly superior reductions in gingivitis (by almost 3x) and bleeding and plaque (by almost 2x) compared to manual brush.
Yaacob M, et al. Cochrane Systematic Review; Power vs. manual brush, 2014. ¹³	56 studies; Included 4,624 subjects	Power toothbrushes reduce plaque and gingivitis more than manual toothbrushing in the short and long term. O-R technology was the only power brush consistently shown to reduce more plaque and gingivitis vs. manual brushing in the short and long term. There was no significant difference between manual brushes and side-to-side (sonic brushes) in the reduction of plaque or gingivitis.
Klukowska M, et al. (P&G); RCT; Oscillating-rotating toothbrush vs. a new sonic brush, 2014. ³⁰	130 Subjects (127 completed); 12 weeks	O-R toothbrush demonstrated statistically significantly greater reductions in whole mouth plaque at Weeks 6 and 12, and significantly greater gingivitis reductions over the long-term (12 weeks), compared to the new sonic toothbrush.

Table 4. Continued

Starke M et al. (Sonicare); RCT; Sonic vs. O-R on gingival health & plaque status with subjects with moderate gingivitis, 2017. ³²	284 subjects; 6 weeks	A new sonic toothbrush was statistically superior to an older model O-R-P toothbrush in reducing gingival inflammation, gingival bleeding, and supragingival plaque following 2 and 6 weeks of home use.
Ccahuana-Vasquez RA et al. (P&G); RCT; O-R vs. Sonic in reducing gingivitis & plaque in those with pre-existing gingivitis and plaque, 2018. ³¹	150 Subjects; 8 weeks	Both brushes reduced MGI, GBI, total number of bleeding sites, whole mouth plaque, gingival margin plaque, and proximal plaque ($p < 0.001$ for each). The O-R brush provided statistically significantly greater reductions than the sonic brush for all gingivitis measures, including # of bleeding sites after eight weeks of use ($p < 0.001$). Significantly greater whole mouth (26.2%) and proximal (38.5%) plaque reductions were also demonstrated at Week 8 for the O-R brush versus the sonic brush ($p < 0.001$).
Goyal CR et al. RCT; Comparison of Waterpik Sonic-Fusion with a traditional sonic and manual toothbrush and flossing, 2018. ¹²	105 Subjects; 4 weeks	WaterPik Sonic-Fusion was significantly more effective than a traditional sonic toothbrush or a manual toothbrush and flossing for reducing gingival bleeding and inflammation.
Wang P et al. Systematic Review with MA; Comparison of the effectiveness between power toothbrushes and manual toothbrushes for oral health, 2019. ³³	21 Studies; Included 2,296 subjects	Power toothbrushes are more effective in reducing dental plaque, gingivitis and bleeding compared to a manual toothbrush.
Mirza F et al. (Sonicare); RCT; Comparison of 2 power toothbrushes on gingival inflammation and supragingival plaque, 2019. ³⁴	222 enrolled, 219 subjects completed; 6 weeks	Sonicare DiamondClean Smart powered toothbrush reduced gingival inflammation more significantly than the Oral-B Genius 8000 powered toothbrush. Both were safe for use.
Grender J et al. (P&G); Systematic Review with MA; on plaque & gingival health; studies conducted by P&G from 2007-2017; 2020. ³⁵	16 Studies; Included 2,145 subjects for gingival health; & 20 Studies, Included 2,551 subjects for plaque reduction; up to 3 months	Gingivitis assessed via number of bleeding sites and standardized changes in average plaque scores. Both O-R and sonic technology reduce bleeding sites and plaque scores better than a manual brush, however using New AAP/EFP Gingivitis Classifications, O-R provides 7.4x significantly greater odds of patients transitioning from gingivitis to generally healthy state ($< 10\%$ bleeding sites). ⁶⁷
Grender J et al. (P&G); RCT; Comparison of New Oral-B iO O-R brush with micro-vibrations and manual brush for gingivitis and plaque reduction with subjects with plaque & gingivitis, 2020. ³⁶	110 subjects; 8 weeks	Using New AAP/EFP guidelines, O-R electric toothbrush with micro-vibrations provided statistically significantly greater plaque and gingivitis reductions versus a manual toothbrush. Odds of transitioning from not healthy ($\geq 10\%$ bleeding sites) at baseline to 'healthy' ($< 10\%$) gingivitis status at week 8 was 14.5x higher than using the ADA manual brush.
Adam R et al. (P&G); RCT; New Oral-B iO O-R brush with microvibrations and premium sonic brush, 2020. ³⁷	90 subjects; 8 weeks	Using New AAP/EFP guidelines, O-R electric toothbrush with micro-vibrations provided statistically significantly greater plaque and gingivitis reductions than the sonic toothbrush. After 8 weeks 84% of subjects moved to healthy state with novel OR brush versus 53% with the sonic brush.

Table 4. Continued.

Lyle DM et al. (WaterPik); RCT; Water flosser + O-R power toothbrush, 2020. ²⁵	70 subjects; 4 weeks	Oral hygiene regimen of a water flosser + O-R powered toothbrush significantly improved gingival health as compared to an O-R powered toothbrush alone.
Clark-Perry D et al. Systematic Review with MA; O-R & other power TBs, 2020. ³⁸	15 Studies; Included 1,968 subjects	O-R toothbrushes had superior, statistically significant outcomes for whole-mouth plaque reduction, ($P < .01$), and gingivitis, assessed by using number of bleeding sites ($P < .001$), but not for the modified gingival index ($P > .05$) or gingival bleeding index ($P > .05$). O-R brush might remove more plaque and reduce the # of bleeding sites better than other power toothbrushes.
Elkerbout TA et al. Comparison of a powered toothbrush with a manual toothbrush, 2020. ⁷¹	17 Studies	There is moderate certainty that the Power TB was more effective than the Manual TB with respect to plaque removal following a single brushing exercise independent of the plaque index scale that was used.
Grender J, et al. The effects of oscillating-rotating electric toothbrushes on plaque and gingival health: A meta-analysis, 2020. ⁶⁸	16 RCTs; 2,145 subjects for gingivitis; 20 RCTs 2,551 subjects for plaque	This subject-level meta-analysis of studies up to 3 months provides sound evidence supporting recommendations for patients with various degrees of gingival bleeding to use oscillating-rotating electric toothbrushes over manual and sonic toothbrushes to improve plaque control and gingival health.
Thomassen TJA, et al. The efficacy of powered toothbrushes: A systematic review and network meta-analysis, 2022 ⁶⁹	28 publications	There is a high certainty for a small effect of a PTB over an MTB. This supports the recommendation to use a powered toothbrush for daily plaque removal. There is moderate certainty for a very small benefit for the use of a powered toothbrush with an Oscillating-rotating (OR) over an High-Frequency Sonic (HFS) mode of action.
Sager P, et al. Powered tooth brushes are beneficial for long-term oral health: Results from the Study of Health in Pomerania (SHIP-TREND), 2023 ⁷⁰	2214 participants	A recommendation of PTB usage in dental practice could contribute to the long-term promotion of oral health.
Graves A, et al. Systematic Review and Meta Analysis of the Relative Effect on Plaque Index among Pediatric Patients Using Powered (Electric) versus Manual Toothbrushes, 2023. ⁷¹	38 studies, 1,626 orthodontic and non-orthodontic pediatric subjects	These results provide strong clinical evidence for recommending electric toothbrushing to pediatric patients, as well as those patients undergoing orthodontic therapy and treatment.
Zou Y, et al. A Meta-analysis Comparing Toothbrush Technologies on Gingivitis and Plaque. 2023. ⁷²	21 Gingivitis RCTs, 25 Plaque RCTs	Oscillating-rotating toothbrushes offer superior results for transition to health, gingivitis, and plaque reduction compared with manual and sonic brushes. The most advanced oscillating-rotating model (iO) offers enhanced efficacy vs traditional models.



Figure 12. Tooth Abrasion.

Image presented with permission from Martin Spiller, DMD.



Figure 13. Gingival Recession.

Image presented with permission from www.implantdentist.co.nz.

grinding the teeth may contribute to recession as can erosive wear.⁴⁴ However, toothbrushing technique, frequency, duration, force of brushing, and the hardness of toothbrush filaments may also contribute to gingival recession.⁴⁵ Therefore, studies have been conducted to address the safety of a power toothbrush compared with using a manual brush.

Power/Electric Toothbrush Safety Data

Most leading electric toothbrushes have been tested extensively both in the laboratory and in clinical trials for gentleness to the dentition and gingivae, including assessments for some brushes of applied pressure (force), incidence of abrasions, and measurement of any associated gingival recession. A study evaluating the brushing force of individuals using a manual toothbrush and three electric toothbrushes with distinct modes of action showed that considerably more force was used by those patients using the manual brush, while less force was used with the electric brushes.⁴⁶ This study was conducted before the safety features such as pressure sensors indicating when too much force is applied, and now with the new iO alerting the user when optimal pressure is applied.

Multiple independent clinical investigations of gingival recession or gingival abrasion have been conducted comparing participants brushing with either an O-R or sonic power toothbrush with those brushing with a manual toothbrush.⁴⁷ Findings from these studies

consistently demonstrated that participants using a power toothbrush did not experience greater gingival recession or gingival abrasion than those participants using a manual toothbrush and concluded that the power toothbrush did not show a higher risk of tooth abrasion compared to the manual brush.⁴⁷ Investigators stated, "... concern that power tooth brushing results in a higher risk for gingival recession is not warranted," and no adverse effects on oral hard and soft tissues were observed.⁵¹

EBDM Basis for Professional Recommendation of Power Toothbrushes

Drugstore shelves are stocked with numerous toothbrush options and regularly see new arrivals. The vast selection and options can prove confusing to patients, who often then look to their dental professional for advice. Should a manual toothbrush or power toothbrush be recommended? There are three key reasons why a power toothbrush is a wise choice.

1. Patient Compliance and Preference

Although the manual toothbrush is still in wide use globally, research shows that most patients do not brush or floss thoroughly, may use too much force, and/or brush for an inadequate amount of time.²⁰⁻²² Power toothbrushes can help overcome these barriers to maintaining good oral hygiene via increased self-feedback and ease of use, and have been shown to enhance motivation and compliance.^{23,24}

It is well known that patients underestimate the amount of time they brush. Actual brushing time can be significantly different than estimated brushing time.⁵⁵ Power toothbrushes with timers enable patients to assess the time spent on brushing. Certain models have timers that signal the patient every 30 seconds, prompting them to switch quadrants and brush for the recommended 2 minutes. Some companies have created apps that incorporate the timers with more advanced technology to deliver personalized coaching by monitoring user habits and giving real-time brushing guidance (See Table 3).

The most recent version of the Oral-B power brush (iO) has a “unique intuitive smart interface,” which includes a timer that counts upward to 2 minutes on the actual brush handle. It’s advanced artificial intelligence allows the brush to track the location of brushing without needing to bring your phone in the bathroom and mount, like previous GENIUS versions.⁹ Earlier research found in a 30-day clinical study, that subjects were 5 times more compliant with twice daily brushing for two minutes when using the wireless remote timer as compared to manual brush users.⁸ More recent studies have also demonstrated improved brushing times, motivation and compliance with electric toothbrushes.^{23,24}

A brushing duration study in preteen and teen youth comparing a sonic power brush (Sonicare Xtreme™) to a manual toothbrush control found that those assigned to the sonic brush for two weeks of home use brushed longer in a final on-site, videotaped session than those who had used the manual toothbrush at home under the same conditions.⁵⁶

For manual brushing to be efficient and prevent disease, the patient must possess a certain skill level, i.e., they must be able to maneuver the bristles skillfully to thoroughly remove plaque at the critical gingival margin and other hard to clean areas. Power toothbrushes on the other hand,

don’t require the same level of proficiency, as the built-in brushing motion and ability to penetrate approximal regions (by some brushes) are inherent in the brush’s bristle action as patients guide the brush. While this is especially valuable for those with limited dexterity (e.g., children, arthritis patients) all patients are likely to appreciate the fact that they don’t need as much instruction or skill proficiency to achieve a clean dentition, and find the power brushing experience more enjoyable. Clinical studies have found increased levels of patient compliance and/or nearly all participants intending to continue with usage of electric brushes.^{8,23,24,57}

2. Clinical Effectiveness

As reviewed previously, many current-generation power toothbrushes have shown convincing evidence of efficacy in reducing plaque, gingivitis, stain and calculus in clinical research of varying study designs, lengths, and patient populations. Notably, a single class of power toothbrushes (O-R) have been shown in several large independent systematic reviews by the Cochrane Collaboration to provide statistically significantly superior short- and long-term plaque and gingivitis control relative to manual toothbrushes.^{63,13} Further, other SRs have reported “There is some evidence that O-R brushes reduce plaque and gingivitis reduction more than side to side brushes (sonic) in the short term.”^{28,35} A more recent systematic review and meta-analysis looking at the evidence from RCTs from 2007 to 2022 came to the conclusion that Oscillating-rotating toothbrushes offer superior results for transition to health, gingivitis, and plaque reduction compared with manual and sonic brushes. The most advanced oscillating-rotating model (iO) offers enhanced efficacy vs traditional models.⁷¹

3. Safety

The safety of modern power toothbrushes has been researched extensively and has consistently been shown not to be a concern. Patients and professionals can feel confident that swapping their manual

toothbrush for an electric toothbrush will not result in increased tooth and/or gingival abrasion and gingival recession, as per the consistent results of clinical research and systematic reviews.

Specific Power Toothbrush Recommendations

Which specific type of power toothbrush is the best fit for a particular patient? Ultimately, the recommendation should be based on clinical effectiveness in plaque, gingivitis, stain, and calculus control and safety, with allowances for patient preference. Dental professionals should consider the breadth of clinical research support, as well as assessments of systematic reviews of independent association such as the Cochrane Collaboration. Power toothbrushes historically have out-performed manual brushes in reducing both plaque and gingivitis.¹³ Certain patient populations are more at risk of gingivitis and need to maintain better plaque control in environments that may have added challenges, such as orthodontics or implants.

Orthodontic Patients

Fixed orthodontic appliances present a unique challenge to standard homecare measures when it comes to removing plaque. Brackets are cumbersome and difficult to clean around effectively.^{58,59} Where poor oral hygiene during orthodontic treatment can impact length of treatment, quality, and outcomes, preventive home care measures are of utmost importance.⁵⁸

With the majority of orthodontic patients being under 18 additional risk factors come into play.⁵⁸ These include consuming sugary snacks or beverages often, having more autonomy over their hygiene routines, and unfortunately noncompliance and lack of motivation is also greater in this age group.^{23,24} However, a 2023 meta-analysis concluded, there is strong evidence for recommending electric toothbrushing to pediatric patients, as well as those patients undergoing orthodontic therapy and treatment.⁷¹

While use of a powered toothbrush in general helps to reduce plaque and gingivitis, when coupled with an interactive brushing experience and an orthodontic specific brush head, greater benefit has been seen in the

home care outcomes of this population.^{23,59,60} In one randomized control trial conducted by Erbe et al., a brush head designed for the unique contour of orthodontic brackets was compared to a regular brush head for an O-R power brush and a manual brush. Both the orthodontic and regular brush head produced statistically significant plaque reduction compared to the manual brush which is consistent with other literature.^{13,59} However, when comparing the two power brush heads together, results showed the specifically designed ortho head produced significant results over the regular brush head alone due to its design and ability to adapt around brackets.

Another randomized control trial aimed to test the ortho specific brush head on an O-R power toothbrush to the regular head of a leading sonic brush. While both technologies reduced plaque post baseline significantly, (60.76% for sonic with regular head, 65.62% for O-R with orthodontic head ($P < .001$)), there was a statistically significant result of O-R over sonic ($P = .017$).⁶⁰

The novel Sonic-Fusion brush by WaterPik® may prove to be a beneficial tool for this population as well. Research has shown that water flossing in addition to brushing alone increases effectiveness of reducing plaque, bleeding, and inflammation.^{25,42} When the WaterPik® Sonic-Fusion brush was compared to a standard sonic brush, and manual brush with flossing, the WaterPik® Sonic-Fusion brush provided significant results overall and interproximally. However, since this product is new, there is no specific research data on using the WaterPik® Sonic-Fusion brush on an ortho population.¹²

A recent RCT investigated two homecare regimens for orthodontic patients and their effects on reducing plaque, gingival inflammation, and bleeding in this population. Subjects were randomized into a control group, which was instructed to use a manual toothbrush and string floss with a threading device, or the intervention group, which was instructed to use a Philips Sonicare EasyClean power toothbrush with InterCare brush head and a Sonicare Airfloss Pro filled with BreathRx antimicrobial mouthrinse for interproximal

cleaning. All products demonstrated safety on both the oral tissues and the orthodontic appliances, however, the powered regimen was significantly more effective at reducing plaque, inflammation, and bleeding after 3 and 6 weeks.⁵⁸

As previously mentioned, compliance and motivation to complete oral hygiene measures while in braces is often low in adolescents. A study conducted on plaque removal and compliance for this age group comparing a manual brush to an interactive power toothbrush showed very promising results. Bluetooth technology that connects the brush with an app was used to try to motivate this age group to brush longer and focus on problem areas. After a 6-week trial, brushing times increased an average of 55 seconds in the interactive power toothbrush group, who also had greater plaque removal overall and in focus areas.²³ With so many adolescents integrating the use of wireless technology into their daily lives, increased motivation and compliance in this population may be seen. This in turn, may show greater reduction in plaque and inflammation.²³

Implant Patients

Implants are an increasingly popular choice for dental patients seeking solutions for missing teeth. They produce predictable results and have survival rates over 90%.^{61,62} In addition to preserving tooth structure and bone of adjacent teeth, patients report increased quality of life with better ability to chew foods.⁶² Once the implant is completed, there is no removable portion to care for, which is an added benefit.

However, it is important to understand the unique anatomy of an implant and how that differs from natural teeth. In addition to size and shape of the implant itself (which can differ quite a bit from a 2 or 3 rooted molar to a single post implant), implants are osseointegrated, meaning there is not a periodontal ligament (PDL) which helps keep natural teeth stable and supported.⁶¹ With the different structures we see slightly different disease processes. In peri-implantitis, there is no PDL space and therefore, infection can

extend into the bone quickly making implants more susceptible to inflammatory processes.⁶¹

Patients should be educated on the importance of homecare prior to implant placement to ensure good routines are in place once the implant is placed. Peri-implantitis is most commonly caused by bacterial plaque around implant sites, therefore, effective plaque removal reduces risk of disease.^{61,63} The last Cochrane review completed on interventions for maintaining tissue health around implants was conducted in 2010. Based on the two studies included in the review, the conclusion was that there was no, or very low, evidence for the recommendation that power brushes performed better than manual around implants.⁶⁴ However, a study conducted in 2018 with an O-R power brush using a specifically designed brush head (Interspace brush head) for areas that require special focus, such as implants (which looks similar to an end tuft brush. See Figure 5a) was compared with a manual brush. This study demonstrated that the O-R brush with the Interspace head can be effective at reducing plaque and bleeding.⁶³

Similarly, little research has been conducted on the WaterPik® Sonic-Fusion brush specifically for implants. However, a RCT comparing string floss to a water flosser demonstrated the water flosser to be statistically more effective in reducing bleeding sites. Thus, water flossing may be a good adjunct for implant maintenance.⁶⁵ For study participants who liked sonic brushes, the combination sonic/ water flosser may be very appealing. Or, for O-R users, adding the use of a WaterPik® water flosser is another option. Research has shown that this option is beneficial as compared to only using an O-R power toothbrush.²⁵

In 2016, Clinical Practice Guidelines for Recall and Maintenance of Patients with Tooth-Borne and Implant-Borne Dental Restorations were created based on best evidence available for making recommendations for this population.⁶⁶ For at home maintenance it is recommended that patients should “be educated about brushing twice daily, and the use of oral hygiene aids such as dental floss, water floss, air flossers, interdental cleaners, and electric

toothbrushes.”⁶⁶ More research needs to be conducted regarding implant maintenance to help strengthen recommendations and establish best practices, since the recommendations are based on very weak evidence.

Patient Brushing Instruction

In-office instruction is important to demonstrate how to use the different brushing technologies. Face-to-face direct communication between the patient and provider should serve as the basis for homecare instruction. Several YouTube and site-specific videos exist demonstrating the different brushing techniques for Oral-B, Sonicare, and WaterPik that can be reviewed in the office and then used by the patient at home for reinforcement and guidance.

SEE INSTRUCTIONAL VIDEOS/PATIENT EDUCATION INFORMATION

- Sonic: [How to brush with Sonicare DiamondClean](#)
- Oral B: [How to brush your teeth with an electric toothbrush?](#)
- WaterPik: [How-To Use Waterpik® Sonic-Fusion® Professional](#) OR [Waterpik® Sonic-Fusion® - Now It's Easy to Floss and Brush 2019](#)
- Oral-B [Kids: Oral-B Kids Electric Rechargeable Toothbrush](#)

- Oral-B Ortho: [Crest + Oral-B OrthoEssentials Program](#)
- Oral-B Implants: [Crest + Oral-B Implant System](#)

Conclusion

Patients are more educated and asking more questions about their oral health. Dental professionals today can be overwhelmed by the number and variety of toothbrushes regularly surfacing on the market and the many differing technologies. All of these advances oblige dental professionals to seek information that will enable them to make the best product recommendations based on proven clinical effectiveness and gentleness, their own clinical experience, and patient preferences.

For the clinician who values a definitive body of peer-reviewed research demonstrating clinical effectiveness in plaque and gingivitis reduction and confirmed safety, both the O-R and sonic modes of power toothbrushes are significantly more effective than a manual toothbrush, with the majority of studies reporting that O-R technology is more effective than sonic technology. In addition, multiple research studies over 4 decades have demonstrated O-R's high patient acceptability and increased compliance, and unlike most other power toothbrushes, all models of O-R brushes have received the ADA Seal of Acceptance. Thus, an O-R electric toothbrush may be the brush of choice.

Course Test Preview

To receive Continuing Education credit for this course, you must complete the online test. Please go to: www.dentalcare.com/en-us/ce-courses/ce648/test

- 1. Power brushes were developed to _____.
A. overcome domination of the manual toothbrush market
B. address the need for more effective alternative to a manual brush
C. encourage patients to brush longer
D. A, B, and C
E. B and C**
- 2. Initially, power brushes were recommended for _____.
A. people with special needs and limited dexterity
B. geriatrics
C. children
D. everyone
E. No recommendations given.**
- 3. Which type of brush was first to demonstrate it was more effective than a manual brush?
A. Side-to-side
B. Circular
C. Counter oscillation
D. Oscillating-rotating
E. Up and down**
- 4. In which ways do power/electric toothbrushes differ?
A. Not all use batteries or electricity
B. Cleaning technology
C. Available brush heads
D. A and B
E. B and C**
- 5. All of the following are TRUE about Battery-powered toothbrushes EXCEPT:
A. May be more effective than a manual toothbrush.
B. Have innovative features such as pressure control.
C. Some batteries cannot be replaced and therefore are a disposable, less expensive option.
D. Brush heads and batteries can be replaced in some models.
E. Less powerful than a powered toothbrush with a rechargeable electric source.**
- 6. Oral-B has specific electric brush heads for all of the following EXCEPT:
A. Implants
B. Orthodontics
C. Children under the age of 3
D. Sensitivity
E. A and C**

7. **The benefit of the Oral-B iO pressure sensor as compared to other pressure sensors is _____.**
- A. to make patients aware when too much pressure is being applied to the tooth surface
 - B. to make patients aware when insufficient pressure is being applied
 - C. to warn you when the battery is running low
 - D. to make patients aware when optimal pressure is applied
 - E. B and D
8. **Power brush head filaments should be _____.**
- A. hard - pointed ends - natural bristles
 - B. soft - rounded ends - nylon bristles
 - C. hard - round ends - nylon bristles
 - D. soft - pointed ends - natural bristles
 - E. hard - rounded ends - natural bristles
9. **EBDM is comprised of _____.**
- A. research and patient preferences
 - B. patient circumstances and Marketing
 - C. clinical expertise and clinical circumstances
 - D. clinician preferences and past experience
 - E. A and C
10. **The purpose of EBDM is to _____.**
- A. emphasize new research findings
 - B. close the gap between research and practice
 - C. defer to a patient's wishes
 - D. use expert opinions
 - E. support current practice
11. **In conducting a search, if a Clinical Practice Guideline is not available what is the next highest level of evidence that you should search for?**
- A. Meta-Analysis
 - B. Clinical Practice Guidelines
 - C. Systematic Reviews
 - D. Randomized Controlled Trials
 - E. Cohort Study
12. **Secondary research differs from primary research in that secondary research _____.**
- A. provides a lower level of evidence
 - B. provides a higher level of evidence
 - C. includes a summary of at least 2 individual studies
 - D. A and C
 - E. B and C
13. **Benefits of conducting a PubMed search to find evidence to answer your question include _____.**
- A. finding articles by their level of evidence
 - B. searching through thousands of journals at the same time
 - C. searching the largest scientific database
 - D. finding all scientific literature that exists
 - E. A, B and C

- 14. Which brush(es) have received the ADA Seal in the Powered Toothbrush Category?**
- A. Waterpik Sonic-Fusion
 - B. Quip
 - C. Sonicare DiamondClean Smart
 - D. Oral-B Pro Series (O/R/P)
 - E. B and D
- 15. When choosing a power brush, the dental professional's recommendation should be based on the clinical effectiveness of all of the following EXCEPT:**
- A. plaque control
 - B. caries prevention
 - C. gingivitis control
 - D. stain control
 - E. calculus control
- 16. Which of the following risk factors can be modified and should be the focus of dental professionals?**
- A. Bacterial plaque
 - B. Host defense mechanisms
 - C. Family predisposition
 - D. Smoking habits
 - E. Systemic disease
- 17. Power brushes focus on _____.**
- A. the removal of supragingival plaque
 - B. the effects of subgingival plaque biofilm
 - C. brushing as quickly as possible
 - D. reducing the clinical signs of inflammation
 - E. A, B and D
- 18. Which modes of action have been proven more effective than manual brushes for plaque and gingivitis reduction?**
- A. circular
 - B. side to side
 - C. oscillating-rotating
 - D. up and down
 - E. B and C
- 19. Evidence suggests that power brushes are more beneficial in reducing _____.**
- A. intrinsic stain
 - B. extrinsic stain such as coffee, tea, and tobacco
 - C. calculus formation
 - D. plaque/biofilm
 - E. B, C and D
- 20. The results of a crossover trial on tartar control comparing manual and power toothbrushes found _____.**
- A. all brushes produced the same effectiveness
 - B. any power brush was superior
 - C. one type of power brush was more efficacious
 - D. the manual brush was far superior
 - E. the short and long-term success has not yet been finalized

21. **Research has shown that more pressure is used when patients brush with a _____.**
A. manual brush
B. electric brush
C. battery powered brush
D. end tuft or sulcus brush
E. interdental brush
22. **Findings from several systematic reviews of published safety data on gingival recession or abrasion found in comparing power and manual toothbrushes that power toothbrushes caused _____.**
A. recession
B. no higher a risk to gingival tissues trauma
C. significant gingival abrasion
D. gingival bleeding
E. increased occlusal decay
23. **Studies have found power toothbrushes with Smart technology _____.**
A. can motivate patients to brush more regularly
B. can motivate patients to brush for longer durations
C. showed no difference between a manual and power brushing
D. do not differ in their effectiveness when comparing the abilities of various brush technologies
E. A and B
24. **A power toothbrush does not require the same level of skill proficiency as a manual brush due to _____.**
A. the built-in brushing motion of the brush
B. the ability of the bristles to penetrate approximal areas
C. maneuvering the bristles to remove plaque at the gingival margins
D. A and B
E. B and C
25. **Which combinations have been proven effective for orthodontic patients?**
A. Sonicare InterCare brush head with Airflossing
B. Oral-B, regular and Interspace brush head combination
C. WaterPik Sonic-Fusion brush combining water picking with sonic brushing action
D. Manual brush and string floss
E. A and B
26. **The BEST method in teaching oral hygiene is _____.**
A. 1:1 dental professional to patient instruction
B. group learning opportunities
C. self-instructional materials
D. self-evaluation
E. webinars

IMPLANT SCENARIO:

After #30 was extracted 3 months ago, Mr. Wilson decided to have an implant placed to maintain the space between #29 and #31. During his hygiene appointment you notice he is exhibiting generalized signs of gingivitis and the tissue around #30 is not looking good. You ask him to show you his homecare routine and ask him how important it is to him to keep the implant. Mr. Wilson replies that it is very important to him to keep it as long as possible. One aspect discussed with Mr. Wilson is the disease process. He now understands that with the implant he is more susceptible to the inflammatory process and developing peri-implantitis and realizes why he must do a better job in eliminating bacterial plaque.

- 27. Guidelines state that you should educate Mr. Wilson on use of _____.**
- A. water flossers
 - B. electric toothbrushes
 - C. interdental cleaners
 - D. tongue scrapers
 - E. A, B, and C
- 28. Features of electric toothbrushes that may benefit him in controlling inflammation and removing the most bacterial plaque is the specially designed implant brush head from _____.**
- A. Sonicare
 - B. Quip
 - C. Oral-B
 - D. Colgate
 - E. Rota-Dent

References

1. Alexander JF. Toothbrushes and Toothbrushing - The Biologic Basis of Dental Caries. Menaker L. (ed). Hagerstown, MD Harper & Row 1980;482-96.
2. Fischman SL. The history of oral hygiene products: how far have we come in 6000 years? *Periodontol* 2000. 1997 Oct;15:7-14. doi: 10.1111/j.1600-0757.1997.tb00099.x.
3. Maes L, Vereecken C, Vanobbergen J, et al. Tooth brushing and social characteristics of families in 32 countries. *Int Dent J*. 2006 Jun;56(3):159-67. doi: 10.1111/j.1875-595x.2006.tb00089.x.
4. Van der Weijden F, Danser MW. Toothbrushes: benefits versus effects on hard and soft tissues - Tooth Wear and Sensitivity: Clinical Advances in Restorative Dentistry. Addy M. (ed). London, UK. Martin Dunitz. 2000.
5. Warren PR, Chater B. The role of the electric toothbrush in the control of plaque and gingivitis: a review of 5 years clinical experience with the Braun Oral-B Plaque Remover [D7]. *Am J Dent*. 1996 Jul;9 Spec No:S5-11.
6. Robinson PG, Deacon SA, Deery C, et al. Manual versus powered toothbrushing for oral health. *Cochrane Database Syst Rev*. 2005 Apr 18;(2):CD002281. doi: 10.1002/14651858.CD002281.pub2.
7. Warren PR. Development of an oscillating/rotating/pulsating toothbrush: the Oral-B ProfessionalCare Series. *J Dent*. 2005 Jun;33 Suppl 1:1-9.
8. Walters PA, Cugini M, Biesbrock AR, et al. A novel oscillating-rotating power toothbrush with SmartGuide: designed for enhanced performance and compliance. *J Contemp Dent Pract*. 2007 May 1;8(4):1-9.
9. Adam R. Introducing the Oral-B iO electric toothbrush: next generation oscillating-rotating technology. *Int Dent J*. 2020 Apr;70 Suppl 1:S1-S6. doi: 10.1111/idj.12570.
10. Clark-Perry D. Oral health promotion: Our top priority. *RDHMAG.com*. 2020 Jun 1. Accessed November 10, 2020.
11. Black C, Hall S, Headstrom P, et al. A new generation of Sonicare power toothbrushes – The FlexCare series. *Compend Contin Educ Dent*. 2007;28(suppl 1):4-9.
12. Goyal CR, Qaqish JG, Schuller R, Lyle DM. Comparison of a Novel Sonic Toothbrush to a Traditional Sonic Toothbrush and Manual Brushing and Flossing on Plaque, Gingival Bleeding and Inflammation: A Randomized Controlled Clinical Trial. *Compendium*. 2018 Jun;39(2) Spec:14-22. Accessed November 10, 2020.
13. Yaacob M, Worthington HV, Deacon SA, Deery C, Walmsley AD, Robinson PG, Glenny AM. Powered versus manual toothbrushing for oral health. *Cochrane Database Syst Rev*. 2014 Jun 17;2014(6):CD002281. doi: 10.1002/14651858.CD002281.pub3.
14. Chapple IL, Van der Weijden F, Doerfer C, et al. Primary prevention of periodontitis: managing gingivitis. *J Clin Periodontol*. 2015 Apr;42 Suppl 16:S71-6. doi: 10.1111/jcpe.12366.
15. Van der Weijden FA, Slot DE. Efficacy of homecare regimens for mechanical plaque removal in managing gingivitis a meta review. *J Clin Periodontol*. 2015 Apr;42 Suppl 16:S77-91. doi: 10.1111/jcpe.12359.
16. Garmyn P, van Steenberghe D, Quirynen. Efficacy of Plaque Control in the Maintenance of Gingival Health: Plaque Control in Primary and Secondary Prevention - Proceedings of the European Workshop on Mechanical Plaque Control. Lang NP. (ed). Berlin, Germany. Quintessence Verlag. 1998;107-20.
17. Caton JG, Armitage G, Berglundh T, et al. A new classification scheme for periodontal and peri-implant diseases and conditions - Introduction and key changes from the 1999 classification. *J Clin Periodontol*. 2018 Jun;45 Suppl 20:S1-S8. doi: 10.1111/jcpe.12935.
18. Dietrich T, Ower P, Tank M, et al. Periodontal diagnosis in the context of the 2017 classification system of periodontal diseases and conditions - implementation in clinical practice. *Br Dent J*. 2019 Jan 11;226(1):16-22. doi: 10.1038/sj.bdj.2019.3.
19. Dietrich T, Ower P, Tank M, et al. Periodontal diagnosis in the context of the 2017 classification system of periodontal diseases and conditions - implementation in clinical practice [published correction appears in *Br Dent J*. 2019 Feb;226(4):295]. *Br Dent J*. 2019 Jan 11;226(1):16-22. doi: 10.1038/sj.bdj.2019.3.

20. Beaglehole R, Myriad Editions., International Dental Federation. The oral health atlas : mapping a neglected global health issue. Cointrin, Switzerland. FDI World Dental Federation. 2009;27.
21. McCracken G, Janssen J, Heasman L, et al. Assessing adherence with toothbrushing instructions using a data logger toothbrush. *Br Dent J*. 2005 Jan 8;198(1):29-32; discussion 24. doi: 10.1038/sj.bdj.4811954.
22. Inglehart M, Tedesco LA. Behavioral research related to oral hygiene practices: a new century model of oral health promotion. *Periodontol* 2000. 1995 Jun;8:15-23. doi: 10.1111/j.1600-0757.1995.tb00042.x.
23. Erbe C, Klees V, Braunbeck F, et al. Comparative assessment of plaque removal and motivation between a manual toothbrush and an interactive power toothbrush in adolescents with fixed orthodontic appliances: A single-center, examiner-blind randomized controlled trial. *Am J Orthod Dentofacial Orthop*. 2019 Apr;155(4):462-472. doi: 10.1016/j.ajodo.2018.12.013.
24. Erbe C, Klees V, Ferrari-Peron P, et al. A comparative assessment of plaque removal and toothbrushing compliance between a manual and an interactive power toothbrush among adolescents: a single-center, single-blind randomized controlled trial. *BMC Oral Health*. 2018 Aug 3;18(1):130. doi: 10.1186/s12903-018-0588-1.
25. Lyle DM, Qaqish JG, Goyal CR, Schuller R. Efficacy of the Use of a Water Flosser in Addition to an Electric Toothbrush on Clinical Signs of Inflammation: 4-Week Randomized Controlled Trial. *Compend Contin Educ Dent*. 2020 Mar 1;41(3):170-177. Epub 2020 Jan 1.
26. Van der Weijden GA, Timmerman MF, Danser MM, et al. The role of electric toothbrushes: advantages and limitations - Proceedings of the European Workshop on Mechanical Plaque Control. Lang NP. (ed). Berlin, Germany. Quintessence Verlag. 1998;138-55.
27. Biesbrock AR, Walters PA, Bartizek RD, et al. Plaque removal efficacy of an advanced rotation-oscillation power toothbrush versus a new sonic toothbrush. *Am J Dent*. 2008 Jun;21(3):185-8.
28. Deacon SA, Glenny AM, Deery C, et al. Different powered toothbrushes for plaque control and gingival health. *Cochrane Database Syst Rev*. 2010 Dec 8;(12):CD004971. doi: 10.1002/14651858.CD004971.pub2.
29. Klukowska M, Sharma N, Qaqish J, et al. Gingivitis reduction from a power toothbrush with novel brush head. *J Dent Res (AADR/IADR)* 2010 Jul 17;89(Spec Iss B):Abstract 3695.
30. Klukowska M, Grender JM, Conde E, et al. A randomized 12-week clinical comparison of an oscillating-rotating toothbrush to a new sonic brush in the reduction of gingivitis and plaque. *J Clin Dent*. 2014;25(2):26-31.
31. Ccahuana-Vasquez RA, Conde EL, Cunningham P, Grender JM, Goyal CR, Qaqish J. An 8-Week Clinical Comparison of an Oscillating-Rotating Electric Rechargeable Toothbrush and a Sonic Toothbrush in the Reduction of Gingivitis and Plaque. *J Clin Dent*. 2018 Mar;29(1):27-32.
32. Starke M, Delaurenti M, Ward M, Souza S, Milleman KR, Milleman JL. A Comparison of the Effect of Two Power Toothbrushes on the Gingival Health and Plaque Status of Subjects with Moderate Gingivitis. *J Clin Dent*. 2017 Mar;28(1 Spec No A):A29-35.
33. Wang P, Xu Y, Zhang J, et al. Comparison of the effectiveness between power toothbrushes and manual toothbrushes for oral health: a systematic review and meta-analysis. *Acta Odontol Scand*. 2020 May;78(4):265-274. doi: 10.1080/00016357.2019.1697826. Epub 2019 Dec 9.
34. Mirza F, Argosino K, Ward M, Ou SS, Milleman KR, Milleman JL. A Comparison of the Effect of Two Power Toothbrushes on the Reduction of Gingival Inflammation and Supragingival Plaque. *J Clin Dent*. 2019 Mar;30(Spec No A):A9-15.
35. Grender J, Adam R, Zou Y. The effects of oscillating-rotating electric toothbrushes on plaque and gingival health: A meta-analysis. *Am J Dent*. 2020 Feb;33(1):3-11.
36. Grender J, Ram Goyal C, Qaqish J, Adam R. An 8-week randomized controlled trial comparing the effect of a novel oscillating-rotating toothbrush versus a manual toothbrush on plaque and gingivitis. *Int Dent J*. 2020 Apr;70 Suppl 1:S7-S15. doi: 10.1111/idj.12571.
37. Adam R, Ram Goyal C, Qaqish J, Grender J. Evaluation of an oscillating-rotating toothbrush with micro-vibrations versus a sonic toothbrush for the reduction of plaque and gingivitis: results from a randomized controlled trial. *Int Dent J*. 2020 Apr;70 Suppl 1:S16-S21. doi: 10.1111/idj.12569.

38. Clark-Perry D, Levin L. Systematic review and meta-analysis of randomized controlled studies comparing oscillating-rotating and other powered toothbrushes. *J Am Dent Assoc.* 2020 Apr;151(4):265-275.e6. doi: 10.1016/j.adaj.2019.12.012. Epub 2020 Feb 26.
39. Elkerbout TA, Slot DE, Rosema NAM, Van der Weijden GA. How effective is a powered toothbrush as compared to a manual toothbrush? A systematic review and meta-analysis of single brushing exercises. *Int J Dent Hyg.* 2020 Feb;18(1):17-26. doi: 10.1111/idh.12401. Epub 2019 Jul 23.
40. Terezhalmy GT, Walters PA, Bartizek RD, et al. A clinical evaluation of extrinsic stain removal: a rotation-oscillation power toothbrush versus a dental prophylaxis. *J Contemp Dent Pract.* 2008 Jul 1;9(5):1-8.
41. Terézhalmy GT, He T, Walters PA, et al. Clinical assessment of extrinsic stain removal efficacy with a new Pulsonic toothbrush. *J Clin Dent.* 2009;20(3):71-4.
42. Sharma NC, Galustians HJ, Qaqish J, et al. The effect of two power toothbrushes on calculus and stain formation. *Am J Dent.* 2002 Apr;15(2):71-6.
43. Bizhang M, Schmidt I, Chun YP, et al. Toothbrush abrasivity in a long-term simulation on human dentin depends on brushing mode and bristle arrangement. *PLoS One.* 2017 Feb 21;12(2):e0172060. doi: 10.1371/journal.pone.0172060.
44. Litonjua LA, Andreana S, Cohen RE. Toothbrush abrasions and noncarious cervical lesions: evolving concepts. *Compend Contin Educ Dent.* 2005 Nov;26(11):767-8, 770-4, 776 passim.
45. Duncan TB, Bowen DM. Toothbrushing, Chapter 24. *Darby and Walsh Dental Hygiene: Theory and Practice*, 5th ed. Bowen DM, Pieran JA (Ed). Maryland Heights, MO. Elsevier, 2020:368-376.
46. van der Weijden GA, Timmerman MF, Reijerse E, et al. Toothbrushing force in relation to plaque removal. *J Clin Periodontol.* 1996 Aug;23(8):724-9. doi: 10.1111/j.1600-051x.1996.tb00601.x.
47. Dentino AR, Van Swol RL, Derderian GM, et al. Comparative Evaluation of the Safety of a Powered vs. a Manual Toothbrush Over One Year. *Amer Acad Perio Ann Meeting.* 1998. Abstract 208.
48. Danser MM, Timmerman MF, Ijzerman Y, et al. Evaluation of the incidence of gingival abrasion as a result of toothbrushing. *J Clin Periodontol.* 1998 Sep;25(9):701-6. doi: 10.1111/j.1600-051x.1998.tb02510.x.
49. Dorfer CE. Tooth abrasion by manual and oscillating-rotating power toothbrushes [628] *J Dent Res. (AADR/IADR)* 2008;87(Spec Iss B):Abstract 2045.
50. Dorfer CE, Joerss D, Rau P, Wolff D. 12-Months Effect of an oscillating-rotating power toothbrush on recession. *J Dent Res.* 2005;84(Spec Iss B):Abstract 632.
51. Dorfer CE, Joerss D, Wolff D. A prospective clinical study to evaluate the effect of manual and power toothbrushes on pre-existing gingival recessions. *J Contemp Dent Pract.* 2009 Jul 1;10(4):1-8.
52. Dörfer CE, Staehle HJ, Wolff D. Three-year randomized study of manual and power toothbrush effects on pre-existing gingival recession. *J Clin Periodontol.* 2016 Jun;43(6):512-9. doi: 10.1111/jcpe.12518. Epub 2016 May 5. doi: 10.1111/jcpe.12518.
53. Van der Weijden FA, Campbell SL, Dörfer CE, et al. Safety of oscillating-rotating powered brushes compared to manual toothbrushes: a systematic review. *J Periodontol.* 2011 Jan;82(1):5-24. doi: 10.1902/jop.2010.100393. Epub 2010 Sep 10.
54. Moore M, Putt M, Jain V, de Jager M. In vitro assessment of dentin wear resulting from the use of the Philips Sonicare DiamondClean power toothbrush. Data on file, 2010. Accessed September 8, 2021.
55. Creeth JE, Gallagher A, Sowinski J, et al. The effect of brushing time and dentifrice on dental plaque removal in vivo. *J Dent Hyg.* 2009 Summer;83(3):111-6. Epub 2009 Aug 14.
56. Milleman K, Putt M, Master A, et al. Comparison of brushing compliance with Sonicare Xtreme e3000 Series versus a manual toothbrush in preteens and teens. *Brushing Duration of Manual Versus Sonic Toothbrushes in Preteens/Teens.* *J Dent Res.* 2006;85(spec Iss B):Abstract 1306.
57. Warren PR, Ray TS, Cugini M, Chater BV. A practice-based study of a power toothbrush: assessment of effectiveness and acceptance. *J Am Dent Assoc.* 2000 Mar;131(3):389-94. doi: 10.14219/jada.archive.2000.0183.

58. Nammi K, Starke EM, Ou SS, Ward M, Jenkins W, Milleman JL, Milleman KR. The Effects of Use of a Powered and a Manual Home Oral Hygiene Regimen on Plaque and Gum Health in an Orthodontic Population. *J Clin Dent*. 2019 Mar;30(Spec No A):A1-8.
59. Erbe C, Klukowska M, Tsaknaki I, Timm H, Grender J, Wehrbein H. Efficacy of 3 toothbrush treatments on plaque removal in orthodontic patients assessed with digital plaque imaging: a randomized controlled trial. *Am J Orthod Dentofacial Orthop*. 2013 Jun;143(6):760-6. doi: 10.1016/j.ajodo.2013.03.008.
60. Erbe C, Jacobs C, Klukowska M, Timm H, Grender J, Wehrbein H. A randomized clinical trial to evaluate the plaque removal efficacy of an oscillating-rotating toothbrush versus a sonic toothbrush in orthodontic patients using digital imaging analysis of the anterior dentition. *Angle Orthod*. 2019 May;89(3):385-390. doi: 10.2319/080317-520.1. Epub 2018 Dec 5.
61. Clark D, Levin L. Dental implant management and maintenance: How to improve long-term implant success? *Quintessence Int*. 2016;47(5):417-23. doi: 10.3290/j.qi.a35870.
62. Elani HW, Starr JR, Da Silva JD, Gallucci GO. Trends in Dental Implant Use in the U.S., 1999-2016, and Projections to 2026. *J Dent Res*. 2018 Dec;97(13):1424-1430. doi: 10.1177/0022034518792567. Epub 2018 Aug 3.
63. Allocca G, Pudylyk D, Signorino F, Grossi GB, Maiorana C. Effectiveness and compliance of an oscillating-rotating toothbrush in patients with dental implants: a randomized clinical trial. *Int J Implant Dent*. 2018 Dec 10;4(1):38. doi: 10.1186/s40729-018-0150-6.
64. Grusovin MG, Coulthard P, Worthington HV, George P, Esposito M. Interventions for replacing missing teeth: maintaining and recovering soft tissue health around dental implants. *Cochrane Database Syst Rev*. 2010 Aug 4;2010(8):CD003069. doi: 10.1002/14651858.CD003069.pub4.
65. Magnuson B, Harsono M, Stark PC, Lyle D, Kugel G, Perry R. Comparison of the effect of two interdental cleaning devices around implants on the reduction of bleeding: a 30-day randomized clinical trial. *Compend Contin Educ Dent*. 2013 Nov-Dec;34 Spec No 8:2-7.
66. Bidra AS, Daubert DM, Garcia LT, Kosinski TF, Nenn CA, Olsen JA, Platt JA, Wingrove SS, Chandler ND, Curtis DA. Clinical Practice Guidelines for Recall and Maintenance of Patients with Tooth-Borne and Implant-Borne Dental Restorations. *J Dent Hyg*. 2016 Feb;90(1):60-9.
67. Trombelli L, Farina R, Silva CO, Tatakis DN. Plaque-induced gingivitis: Case definition and diagnostic considerations. *J Periodontol*. 2018 Jun;89 Suppl 1:S46-S73. doi: 10.1002/JPER.17-0576.
68. Grender J, Adam R, Zou Y. The effects of oscillating-rotating electric toothbrushes on plaque and gingival health: A meta-analysis. *Am J Dent* 2020 Feb;33(1):3-11.
69. Thomassen TJA, Van der Weijden FGA, Slot DE. The efficacy of powered toothbrushes: A systematic review and network meta-analysis. *Int J Dent Hyg*. 2022 Feb; 20(1): 3–17. (Published online 2021 Dec 31)
70. Sager P, Kocher T, Pitchika V, et al. Powered tooth brushes are beneficial for long-term oral health: Results from the Study of Health in Pomerania (SHIP-TREND). *J Clin Periodontol* 2023 May;50(5):548-558.
71. Graves A, Grahl T, Keiserman M, et al. Systematic Review and Meta Analysis of the Relative Effect on Plaque Index among Pediatric Patients Using Powered (Electric) versus Manual Toothbrushes. *Dent J* 2023 Feb 9;11(2):46-64.
72. Zou Y, Grender J, Adam R, Levin L. A Meta-analysis Comparing Toothbrush Technologies on Gingivitis and Plaque. *Int Dent J* 2023 July 20.

Additional Resources

- No Additional Resources Available.

About the Authors

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Lesley has over fifteen years of experience as a registered dental hygienist. In addition to working part-time in clinical practice, she currently is an educator, clinician, and researcher with The Breathe Institute, Los Angeles. She completed her undergraduate education in Massachusetts at both UMass, Amherst (BS, Sport Management) and Middlesex Community College (AS, Dental Hygiene). In 2014, Lesley graduated from the University of Southern California with her MSDH. Lesley continues to further her education in the area of orofacial myology focusing on health promotion and prevention from a functional approach, working collaboratively with other dedicated medical professionals. Lesley is a member of the American Academy of Physiological Medicine & Dentistry, American Dental Hygienists' Association and has held board positions for the Los Angeles Dental Hygienists' Society, Academy for Sports Dentistry and the National Center for Dental Hygiene Research & Practice.

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