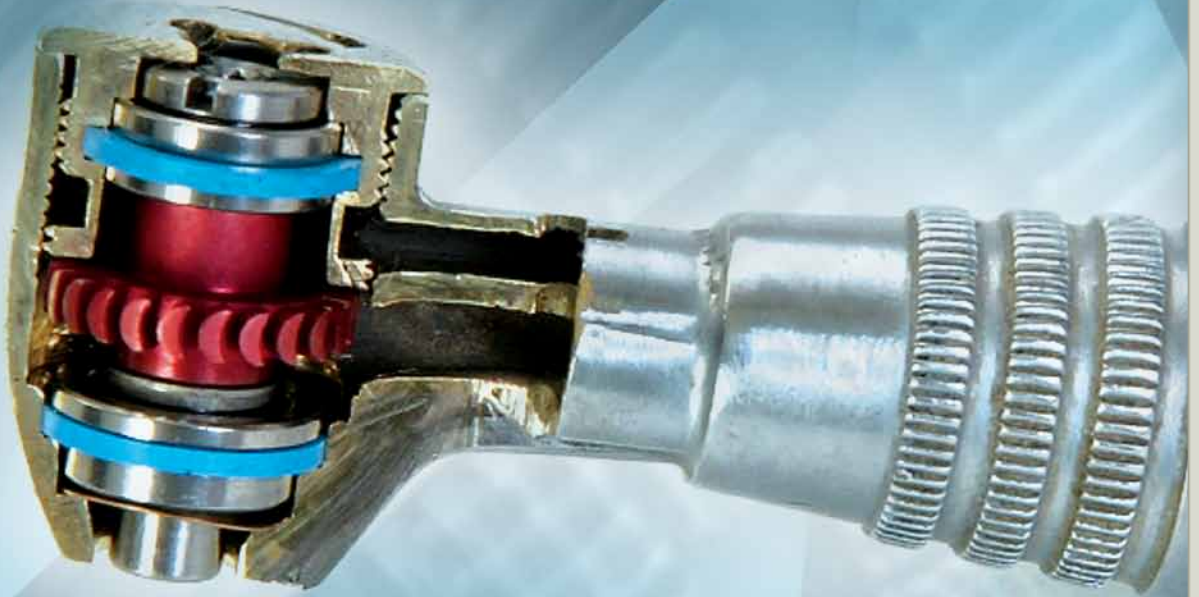


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Anatomy of a Handpiece: Understanding Handpiece Maintenance and Repairs

A Peer-Reviewed Publication
Written by Glenn Williams, BS

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Educational Objectives

The overall goal of this article is to provide the reader with information on current air-driven and electric handpieces. Upon completion of this course the reader will be able to do the following:

1. List and describe the major components of air-driven high-speed handpieces and electric handpieces
2. List and describe the main differences between air-driven high-speed handpieces and electric handpieces
3. List and describe the signs of failure for air-driven and electric handpieces
4. List and describe the maintenance steps for air-driven handpieces
5. List and describe the options for repair/rebuild of air-driven handpieces and considerations in selecting one.

Abstract

Today's clinician is extremely dependent on the handpiece to sustain a smooth-running practice. The handpiece is an incredibly sophisticated device that requires a diligent maintenance protocol to keep it running properly and safely; routine, repeated heat sterilization has the most adverse effect on the dental handpiece. Perhaps due to this dependency on handpieces, combined with the damage resulting from repeated routine sterilization and the need for consistent maintenance, the handpiece has earned an undeserved reputation for excessive breakdowns. The dental team can keep handpieces functioning smoothly longer, and maximize the return on the significant investment the dentist has made in handpiece technology, through appropriate maintenance procedures. Careful selection from repair options is also required.

Introduction

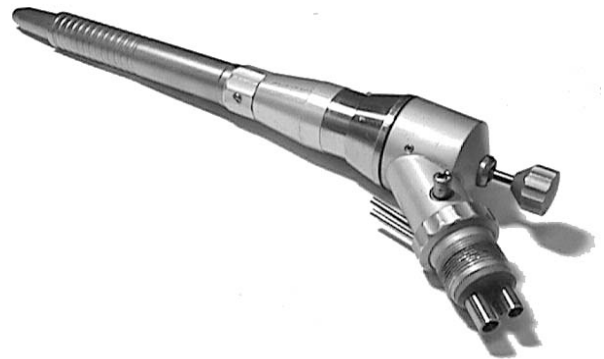
The dental handpiece of today is a sophisticated combination of precision parts moving in perfect synchronization at extremely high speed. This combination delivers a smooth, powerful cut that allows the clinician to remove tooth structure in an efficient manner with as little discomfort to the patient as possible. In contrast, up until the 1950s all dentistry was performed with electric belt-driven instruments with top rotational speeds of 50,000 rpm. This relatively slow speed increased the time spent on tooth preparation and was also extremely uncomfortable for the patient, who experienced much pressure and vibration. The belts that ran the handpieces were heavy and restrictive and tangled with any nearby hair. The leap from belt-driven to air-driven handpieces in the United States was made by Dr. John Borden during the 1950s, and pioneering work for the air-driven high-speed handpiece was performed by Sir John Walsh in New Zealand.^{1,2}

Figure 1. First-generation air-driven high-speed handpiece



This new technology paved the way for higher cutting speeds, which dramatically reduced the time involved in preparing teeth for restorative treatment. As the air turbine handpiece evolved, other problems such as increased concentricity were solved. This resulted in a smoother cut with better margins and less vibration transferred to the patient, and water spray was introduced to cool the tooth surface due to the heat generated from the much higher speeds. Dentistry was revolutionized starting in the early 1970s as traditional treatment methodology gave way to more modern methods of delivering treatment in an environment that was more comfortable for both the patient and dentist. "Sit-down dentistry" and "four-handed dentistry" were introduced, along with reclining patient chairs and multiple simultaneous patient appointments. Most of what we now take for granted as "restorative dentistry" was made possible because of the advancing technology of the air-driven handpiece.

Figure 2. Air-driven low-speed handpiece circa 1968



Evolving Handpiece Technology

As more manufacturers entered the marketplace throughout the 1980s, the handpiece industry evolved. New features were introduced, including the placement of optic fibers through the handpiece to deliver light directly to the cutting area at the tip of the bur. Various automatic chucking mechanisms were also developed in an effort to speed up the changing of burs, and with the advent of the "autochuck," the need to use two high-speed handpieces at once (so that the assistant could change the cutting instrument while the dentist was working with a different bur) was eliminated. Most clinicians now change their own burs effortlessly in seconds. The next improvement came in the form of a swivel connector incorporated into the design of the handpiece to reduce the amount of "tubing torque." Tubing torque is defined as the resistance or drag the operator feels from the weight of the tubing transferred through the handpiece, and creates a tendency for the handpiece to resist rotating in the operator's hand or to spring back after being rotated during a procedure. Most swivels were designed as quick disconnects, which facilitated the removal of the handpiece for *daily* lubrication.

At this point, handpieces required oil only once daily and average turbine life was measured in years. This soon changed with the increased awareness of infectious diseases, including the relatively new disease known as AIDS. Debate ensued over proper infection control protocols within the dental treatment room. On May 20, 1992, millions of Americans sat watching their televisions, not knowing that dentistry and the handpiece industry were about to change virtually overnight. That evening, CBS “Street Stories” and NBC “Dateline” aired controversial stories about the lack of handpiece sterilization in the dental practice. This night marked a turning point and changed forever the way handpieces are purchased, used, and maintained. In 1992 a report was published, based on laboratory studies, recommending routine heat-treatment of handpieces.³ Shortly prior to this, a tragic event had made headlines: a young woman in Florida, Kimberly Bergalis, became infected with the AIDS virus under highly questionable circumstances.⁴ News media sources were quick to associate this tragedy with the young woman’s dentist. Televised congressional hearings in 1993 focused national attention on the dental industry, and soon after this the FDA issued the first guidelines mandating routine handpiece sterilization for private dental practices.^{5,6} The handpiece was soon to become one of the most troublesome workhorses in the dental office, placing increasing demands on staff time and increasing handpiece costs, which until then had been a minimal overhead expense.

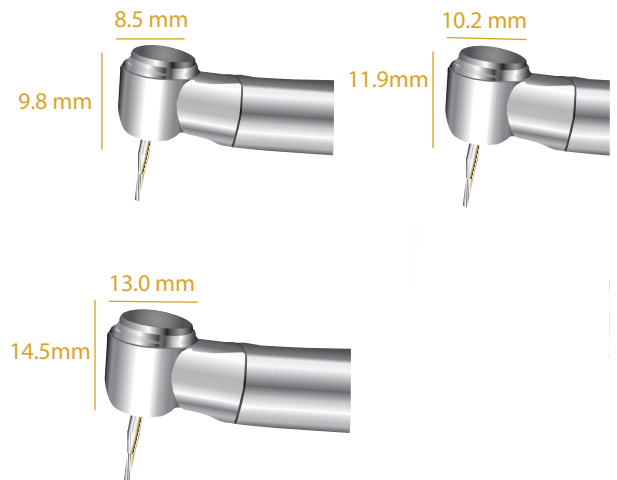
Criteria for Selecting Air-Driven High-Speed Handpieces for Clinical Use

Investing in a handpiece system can quickly add up to become a significant capital expense, and there are also the long-term operational costs of handpiece maintenance to consider. Therefore, the clinician should apply careful consideration to the features, reliability, and maintenance requirements of a particular handpiece model when evaluating different brands for a purchase decision. To complicate the process, FDA regulations prohibit handpiece manufacturers from accepting opened product back from customers not satisfied with their purchases. For this reason, the purchaser should request a demonstration handpiece be supplied so that it can be incorporated into the practice for some period of time under real-life operating conditions before making a final decision. The following list of possible criteria to be considered may serve as a useful guide when selecting a new handpiece system.

Head Size and Angulation: Historically there has been a natural trade-off between head size and cutting power. Most manufacturers offer different models featuring a large and a small head design. A small head size improves visibility and access, especially in the posterior region, while larger head sizes incorporate a larger turbine impeller with more inertial mass that can yield higher power output. More cut-

ting power equals less time involved in tooth preparation. Head angulation is another feature that some manufacturers have taken steps to improve. The typical handpiece head is angled back at 22.5 degrees so that the cutting instrument remains in line with the operator’s line of sight, however this can sometimes restrict access to posterior teeth by causing the handpiece to come in contact with the maxillary arch. Newer designs feature a unique head angle to increase posterior access and patient comfort.

Figure 3. Handpiece head sizes



Sound Level: Dental professionals are at risk for hearing loss from the long-term effects of proximity to high-speed handpiece noise over a career. Elevated handpiece noise levels can also cause patient discomfort and increased anxiety. In recent years, newer handpiece models with lower noise levels have become available, operating in a range of 58 to 71 decibels (dB).

Ergonomic Design: The minutes the clinician spends holding a handpiece constitute a significant portion of an eight-hour treatment day, and over the course of a career, long-term health issues can manifest in the form of carpal tunnel syndrome, resulting from holding a heavy or awkward handpiece. Different handpiece models can vary significantly in length, weight, and balance. A good way to determine the best fit and feel for your hand is to actually use the handpiece in your practice, not while standing in a booth at a dental meeting.

One recent trend in handpiece design is a wider, flared body shape toward the rear of the handpiece, which reduces the pinching force required to grip the handpiece, thereby reducing hand and wrist fatigue. The addition of a fully rotating swivel connecting the handpiece to the delivery tubing significantly reduces the “tubing torque” felt by the operator. Without a swivel, the operator is fighting this constant resistance throughout the day, which can lead to fatigue and injury over time.

Figure 4. Air-driven high-speed handpieces



Water Delivery: All high-speed handpieces incorporate a water spray as a coolant; the latest innovation is a multiport spray emanating from the face of the handpiece. This provides even distribution of coolant water over the entire surface of the tooth and prevents the water spray from being blocked when cutting is performed on the distal surface of a tooth.

Fiber Optics: Fiber optics enhance operator visibility. Cellular optics have been introduced that are made from one solid glass rod instead of a collection of optic fibers. The newest innovation in optics is an LED lightbulb that generates a brighter, whiter light. Most existing systems are retrofittable to an LED lightbulb.

Autoclavability: Handpiece manufacturers are constantly seeking improvement in their handpiece designs to better withstand the harmful effects of the autoclave. Materials from bearing retainers to O-rings have evolved through several generations to higher-temperature heat-resistant components. New materials such as titanium are used for the handpiece body or shell, or special coatings are applied to help preserve the handpiece's external finish.

Electric Handpieces

The single biggest difference in comparing an electric handpiece to an air-driven handpiece is its constant speed. With an electric handpiece, there is no difference between free-running speed and active speed, due to the amount of power generated by the electric motor driving the handpiece, and no power is lost while cutting tooth structure. Another advantage of the new electric handpieces is that they are significantly quieter than air-driven handpieces. An electric handpiece consists of an entire system. A control box must be mounted on the delivery unit, and a conventional delivery tubing plugs into the box, which provides signal air and water, enabling the motor to be operated from the foot control already in use. The control box has digital settings so the operator can literally dial in the exact speed at which he or she would like the bur to rotate. Lightweight tubing extends from the control box to the motor. Electric motors look and feel like cylindrical low-speed air motors

and produce a very quiet hum as opposed to the high-pitched whine of an air-driven high-speed handpiece. Fiber optics and multiport water spray are delivered through the attachments.⁷

Figure 5. Electric handpiece unit and attachment examples



Any number of attachments with various gearing combinations will connect onto an electric motor. The most commonly used attachment for operative dentistry is a 1:5 step-up referred to as a “high speed” attachment. Most electric motors operate at 40,000 rpm; adding a 1:5 speed-increasing attachment provides 200,000 rpm at the bur. This speed remains constant no matter how aggressively the clinician is cutting, and the advantage is much faster preparation time. There is a learning curve associated with mastering this increased power. Electric attachments are generally universal, meaning that any brand will work with any motor. One exception is the new Comfort Drive[®] by Kavo, a more compact design.

There are a few trade-offs to be aware of with electric handpieces. Together, the attachment and the motor are similar to working with a low-speed handpiece in your hand, versus the shorter and lighter high-speed air-driven devices. This may be of particular concern to operators with a smaller hand size. On the other hand, many users report that since the actual cutting time is reduced, this offsets any limitations based on size and weight. Electric handpieces have been found to be more efficient than air-driven high-speed handpieces.⁸ Head size is also typically larger than with the average high-speed air-driven handpiece. A major investment is associated with equipping an office with electric technology, with the cost for a complete system beginning at around \$3,500, and there are additional costs for each attachment required for sterilization redundancy. Electric handpieces consist of several complex parts – the attachment is more similar to a gear-driven low-speed than to an air-driven high-speed handpiece. A series of drive shafts and transmissions increase the rpm of the handpiece from 40,000 where it connects to the motor up to 200,000 in the head. This intricate array of gears and bearings makes repair more costly than for air-driven high-speed handpieces.

Figure 6. Internal working of an electric handpiece



Unlike an air-driven handpiece, which loses torque as the turbine components wear, the electric motor is so powerful that it will continue to drive the attachment as internal parts fail. Even after bearings or gears disintegrate, the motor will continue to operate the handpiece, and this increased friction leads to heat that can burn a patient. On September 23, 2010, the FDA issued a second safety alert regarding reports of serious patient tissue damage due to overheated electric attachments during dental treatment procedures.⁹ The operator must be aware of any sensation of heat in the handpiece or the head. It is imperative that you stop using an electric handpiece immediately if you feel any heat during use. This simple precaution will, most importantly, prevent patient injury and will also reduce the cost of repair by not causing further damage to internal parts.

A Hybrid Air-Electric Handpiece

The latest evolution in handpiece design is the Stylus ATC[®] by Midwest. This system resembles an electric installation but is referred to as a hybrid, using both air pressure and electricity. ATC refers to Adaptive Torque Control[®] and uses a sensor in the handpiece tubing to operate a valve that continuously regulates the amount of air pressure flowing to the turbine. Instead of the handpiece losing power and free-running speed when the bur contacts the tooth, the valve opens, sending more pressure to the turbine to compensate. This constant active speed delivers the same torque curve as an electric handpiece does. The benefit to the clinician is a handpiece with the power of an electric handpiece but size and weight characteristics similar to those of a high-speed air-driven handpiece.

Figure 7. Torque control unit



Routine Sterilization of Handpieces

Prior to the 1990s, dental handpiece sterilization was not an issue, and while handpiece manufacturers maintained that handpieces were autoclavable, there was little practical call for testing those claims. However, once clinicians began to sterilize handpieces between patients, they began to experience a variety of performance problems. Handpiece life expectancy dropped dramatically due to the stresses of repeated sterilization, and handpieces required substantially more service and repair. Rather than lasting for several years and requiring little if any maintenance, handpieces now showed signs of extreme wear within a year or less. How long does a handpiece turbine last? This is perhaps the most frequently asked question related to handpiece purchase and repair. It is difficult to quantify life expectancy under sterilization conditions because of the tremendous number of variables associated with turbine life: lubrication, type of sterilizer, conditions of use, number of use/sterilization cycles per day, and maintenance practices of the individual office.

Two noteworthy independent studies devoted to quantifying handpiece longevity under continued sterilization have been published. The United States Air Force Dental Investigative Service (DIS) at Brooks Air Force Base is responsible for dental product evaluation for all branches of the military and in 1993 conducted an extensive study to determine the life expectancy of a handpiece subjected to ongoing use and sterilization. DIS measured ten performance parameters on nine different handpiece models subjected to 1,000 use/sterilization cycles. Each handpiece was properly maintained and subjected to simulated clinical use prior to every sterilization cycle. DIS concluded that the clinician can expect a handpiece to survive approximately 500 sterilization cycles without significantly reduced performance, if the handpiece is properly maintained.¹⁰ In October 2000, Clinical Research Associates (CRA) published very similar results from a long-term study performed with four different models of handpieces. CRA concluded that with proper maintenance the handpiece models tested should achieve at least 539 use/sterilization cycles before failure. Five hundred cycles for a handpiece used and sterilized twice a day, five days per week, would translate into approximately one year of clinical service.¹¹

Air-Driven Handpiece Component Parts and the Impact of Sterilization

Understanding handpiece components and how they work and learning how to maintain them properly can help clinicians reduce expense and realize long, dependable service from their handpieces. An air-driven high-speed handpiece consists of two main components: the body, or shell, through which air and water are delivered, and the turbine. Each element is affected differently by repeated heat sterilization.

Body or Shell

Brass is the most common material used in handpiece manufacturing; it is a relatively inexpensive material and easy to machine, although it is soft and susceptible to denting. Cosmetic protective plating is applied over the brass but can discolor or flake off over time as a result of sterilization. Stainless steel is another material commonly used to make handpiece bodies. Steel is lighter and stronger than brass, but its use results in higher manufacturing costs, so the prices are generally higher. The current state-of-the-art in handpiece construction is titanium, which is 40 percent lighter than stainless steel and stronger and more resistant to the corrosive effects of autoclaving.

Figure 8. Body or shell



Figure 9. Corrosive effects of sterilization



The body shell of most handpieces comprises two parts: the head that houses the turbine and an outer sheath. Problems have been experienced with the heads separating from the outer shell as a result of heat processing, and various methods have been employed in the past to join these two parts together. However, the joint is a weak area, and further stress is introduced with pushbutton-type bur changing. The joint between the head and body can loosen, and the head can become too dented and affect the turbine operation.

Older-generation handpieces contain bundles of tiny light-transmitting glass fibers held together with adhesive; these bundle optics degrade and darken over time with repeated sterilization. Most new handpiece models employ cellular, or fused-rod, optics. Manufacturers claim that virtually no degradation occurs with cellular optics and back their claims with a five-year warranty. However, cellular optics are more fragile and will not survive a severe drop without fracturing.

Air and water are delivered through the body to the handpiece head. This includes drive air (used to rotate the turbine), coolant water, and chip air (often used to atomize the water spray). After the drive air is passed through the turbine, it is exhausted through the hollow body of the handpiece and down the handpiece tubing. A major problem associated with handpiece sterilization is the continual buildup of rust and corrosion that naturally occur in the steam-saturated environment of the autoclave. One way internal corrosive buildup negatively impacts handpiece performance is a gradual closing off of the handpiece exhaust ports, leading to increased backpressure around the turbine. This results in loss of turbine speed and power. Air and water lines are more prone to clogging as a result of sedimentary buildup in the recirculated

water of older sterilizer models utilizing a reservoir. Newer sterilizer designs provide a fresh charge of distilled water for every steam cycle, greatly reducing the susceptibility to clogging. The latest handpiece models feature a multi-port water spray that disperses water evenly around the work area. These systems, however, incorporate tiny O-rings that break down with repeated sterilization.

The Air-Driven High-Speed Handpiece Turbine

The component that fails most often on a high-speed air-driven handpiece is the turbine; as this degrades, the handpiece exhibits signs of impending failure that are all too familiar to the dental team.

Figure 10. High-speed turbine Figure 11. Effects of wear and sterilization



Turbines rotate at speeds ranging from 380,000 to 450,000 rpm, faster than anything else on the planet. Turbine speed can be categorized as free speed and active speed.¹² Free speed is the maximum rpm with no load. Active speed is the actual speed the turbine is reduced to when the cutting instrument engages the tooth structure. Most high-speed handpieces have an active speed in the range of 180,000 to 200,000 rpm. This extremely high speed allows the clinician to cut through hardened tooth structure with ease, leaving a smooth, clean margin, with reduced trauma to the surrounding structure and tissue. As the turbine bearings wear, speed decreases. Clinically, this results in longer preparation times with slower cutting and rougher margins. Power, also referred to as “torque,” is the measure of the handpiece’s ability to remove tooth structure and is expressed as watts of energy, while torque is measured in oz/inch. Handpieces used to generate 10 to 13 watts, while newer handpiece models produce 15 to 18 watts and have smaller head sizes. The greater the power available to operate the cutting instrument, the less physical demand is placed on the operator’s hand and wrist, which means less fatigue and reduced risk of long-term injury.

Concentricity can be defined as the ability of the handpiece to produce a cutline consistent with the diameter of the bur. The more concentrically a handpiece operates, the smoother the bur cuts, with less perceptible vibration and greater comfort for the patient. The International Standards

Organization (ISO) specifications¹³ allow up to 0.03 mm of eccentricity, commonly referred to as “run out” or “bur wobble.” Concentricity – one of the most critical features of handpiece performance – diminishes as the turbine deteriorates, and a pronounced lack of concentricity can be visible to the eye. Bur retention is another critical feature of today’s automatic chucking mechanisms. Sterilization affects autochucks in different ways. Autoclaving causes accelerated chuck failure when heat causes the springs that provide gripping force to lose their temper and strength, while corrosion dulls the sharp edges used to grip bur shanks. Clinically, autochuck failure is manifested as the bur working out of the chuck during use, which creates a very dangerous situation.

In spite of significant technological advancements in handpiece design over the last ten years, dental professionals continue to experience recurring handpiece problems resulting from sterilization. Misconceptions abound throughout the dental field about exactly what goes wrong when a handpiece turbine fails. Closer examination of the turbine may shed light on just what is happening inside your handpiece.

The Handpiece Turbine Assembly

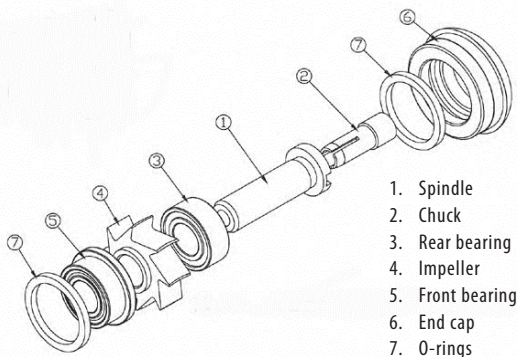
As the only moving part inside a high-speed handpiece, the turbine is the most common source of problems. A high-speed turbine contains two components: a chucking mechanism to hold the cutting instrument and a rotary system that spins the bur at speeds up to 6,000 times per second when air pressure is supplied.

Figure 12. Handpiece turbine assembly



The rotary system consists of an impeller, or rotor, which “catches” drive air (similar to a water wheel), mounted on a spindle. The spindle rotates clockwise at high speeds, supported by two precision bearings and two suspension O-rings.

Figure 13. High-speed air-driven turbine components



These miniature bearings are the heart of the turbine. As reported in the 1993 DIS study, “... handpieces do not fail gradually because of decreased speed and power but, rather, fail as a result of catastrophic failure of the turbine bearings.” The most critical element of these bearings is the retainer, or cage, that secures the ball bearings within the raceways. This becomes brittle as it is subjected to harsh sterilization environments; upon failure, the bearing cage disintegrates and the turbine will no longer rotate or generate power. You will most often see evidence of this final degradation when “black stuff” is expelled from the handpiece head during use or lubrication procedures. The dentist may also note that the bur will “stall out” when applied to tooth structure. Other symptoms of bearing failure include the bur no longer spinning concentrically, unacceptable vibration when the handpiece is activated, or unusually loud sounds emanating from the turbine.¹⁴

Figure 14. Bearing retainer showing stages of degradation



Improved cage materials and manufacturing processes have extended handpiece life since the advent of routine sterilization, as evidenced by the longer warranties prevalent today. Other design improvements offer the clinician the choice of maintenance-free (“lube-free”) handpieces. This is accomplished by saturating the bearing cage with a food-grade, autoclavable grease that gradually releases onto the ball bearings over time through use and sterilization. The bearings are not really “lubrication free.” They are “maintenance free,” however, as it is no longer necessary for the staff to apply lubricant. One of the latest innovations in dental bearing applications is a bearing cage coated with a layer of pure silver. According to a leading bearing manufacturer, the new silver composite retainers combine the lubricating capabilities of metallic silver with strength and the ability to withstand repetitive autoclave cycles.

Prolonging Handpiece Life Through Proper Use and Maintenance

Much can be done to prolong handpiece life by understanding the importance of variables that can be controlled within the practice and by understanding and adhering to some basic handpiece maintenance.

Proper Air Supply

One of the most frequent causes of premature bearing failure is excessive air pressure entering the handpiece. Every handpiece head has a specific capacity for exhausting air. Additional air tends to accumulate around the turbine and may reduce speed. An accurate reading for handpiece air pressure can be obtained only by using an in-line air gauge

to measure air pressure directly at the handpiece connection (the air pressure gauge on the front of the dental unit is little more than a relative indicator and does not account for frictional air loss through the tubing). Some manufacturers incorporate a valve inside the handpiece that regulates incoming air to prevent excessive pressure from reaching the turbine. The quality of the drive air can also impact turbine life. Oil and condensation accumulate in the compressor tank during normal operation, and without proper drying or filtration, oil and water may travel through the air lines to the handpiece tubing. These particles then impact the delicate turbine at high speed, like marbles tossed against a spinning fan. You can easily check drive air quality by aiming an empty hose at a mirror or facial tissue. Any water or oil will show up as moisture or discoloration on the surface. If you have doubts about your air quality or pressure, contact a service technician to inspect dryers, filters, and connections and drain the compressor tank.

Cutting Instruments

The cutting instrument itself can have an impact on turbine life. Overusing dull burs may cause the operator to exert more lateral force against the tooth structure, thereby increasing the side load on the bearings and resulting in excessive friction while operating the handpiece. Using a surgical-length bur, or simulating one by extending the bur from the chuck a few millimeters, can significantly affect the load on the turbine. The longer the cutting instrument, the greater the negative impact on concentricity. Burs should be seated fully into an autochuck and never extended. Conversely, short-shanked burs should never be inserted into a chuck past the taper on the shank. Inferior-quality burs with variable shank diameters overextend the springs in autochucks, leading to premature failure. It may seem obvious – the nature of the dental practice can also have an impact on turbine life. A high-volume crown and bridge practice cannot hope to achieve the same life span from a handpiece as can a pediatric dentist or periodontist, who typically uses a handpiece less often and with less force.

General Handpiece Maintenance Procedures

A number of steps are mandatory in the general handpiece maintenance protocol.

Air-Driven High-Speed Handpieces

1. Surface Clean the Handpiece: Prior to removing a handpiece from the air line, CDC guidelines call for flushing water through the handpiece in the operator for 30 seconds to remove potential contaminants from the internal water line. Then use a brush under running water to remove any bio burden from the exterior of the handpiece. Hold the handpiece upright to reduce the amount of water entering the head of the handpiece. Do not use any chemical solutions for cleaning. Chemicals

can create reactions during the sterilization cycle that have a detrimental effect on the sterilizer and the handpiece.

- 2. Dry the Handpiece:** This step is important, especially if the office is using a chemiclave, or cassette-type sterilizer with a vacuum chamber. Excess water can lead to corrosion inside the handpiece.
- 3. Lubricate the Handpiece:** Use the proper lubricating tip to spray oil into the drive air line; spray until oil comes out of the handpiece head, to ensure that the lubricant has penetrated to the bearings. Even if the lubricant is delivered incorrectly, oil coming from the head indicates it has reached the bearings. If you prefer a dropper, apply two or three full drops to the drive air line and immediately run the handpiece (the droplets will not be delivered to the bearings without being propelled by pressurized air).
- 4. Run the Handpiece to Expel Excess Oil:** After lubrication, it is important to run the handpiece to evenly distribute oil through the bearings and chuck mechanism and to expel excess oil to prevent coagulation during autoclaving. Install a bur in the chuck and run the handpiece for 20 seconds. Do not use a bur blank - they are not made to ISO specifications, do not run concentrically, and may damage the turbine. (Note: Some manufacturers specifically state NOT to install a bur prior to operation.)
Air flush stations located in the sterilization area are an excellent investment. A flush station eliminates a return trip to the operator to run the handpiece. These stations are readily available from many sources and require only a connection to compressed air. Most stations have a handpiece adapter that operates the handpiece upon depressing. Using an air station also prevents oil from being exhausted back into the handpiece tubing, leading to discoloration and stiffening. Remove the bur after operating. Lever-style handpieces must remain in the closed position during sterilization.
- 5. Clean Fiber-Optic Surfaces:** Alcohol and a Q-tip may be used to remove excess oil and debris from all fiber-optic surfaces, which will prevent buildup and discoloration.
- 6. Bag the Handpiece:** CDC guidelines recommend bagging all instruments and handpieces to maintain sterility. A paper/plastic combination bag allows steam to evaporate through the paper side while the contents remain readily identifiable.
- 7. Sterilize:** Autoclave the handpiece following the manufacturer's guidelines. Be sure to place the bag paper side up in the autoclave. Allow the sterilizer to completely process through the dry cycle. This step is CRITICAL. If still damp after completion of the full sterilization cycle, leave the bagged instruments in the autoclave until the packaging is dry.

Figure 15. Proper lubrication of handpiece



Air-Driven Low-Speed Motors and Attachments

CDC guidelines indicate that “only the portion of the attachment that comes in contact with patient tissue” is required to be sterilized, or disposed of. It is not necessary to sterilize the motor if a barrier is used. If you are not autoclaving motors, make sure they are removed from the tubing and lubricated at least once a week. Not removing motors at some interval leads to the accumulated disinfectant corroding the threads onto the tubing permanently. Motors, especially rotary vane models, do not require much oil. Dental motors and attachments require higher viscosity oil than a high-speed spray. One or two drops of oil in the drive air line are all that is necessary. Run the motor to distribute the oil. Also apply some oil as a preventative measure to forward/reverse valves, shift rings, and sheath attachment points. Wipe away excess oil with a paper towel. Most straight attachments do not require lubrication. Perform an external cleaning with a brush under running water prior to bagging the sheath or nose cone for sterilization.

Figure 16. Low-speed attachments



It is very important to take latch angles apart for proper lubrication. If you are processing angles routinely, at least once a day unscrew the head from the sheath and remove the transmission gear for cleaning and oiling (try doing this first thing in the morning as part of the opening routine). Apply a drop of oil under each gear on the transmission gear as well as in the center hole. Apply several drops of oil to the exposed cartridge while the transmission gear is removed.

Figure 17. Latch head components



Handpiece Lubricants

During the initial warranty period, you should always follow the manufacturer’s suggested maintenance procedures and use the approved lubricant supplied with a new handpiece. It is important to follow these instructions to the letter to avoid any disputed warranty claims should your handpiece fail under warranty. The same is true when you purchase or have a new original manufacturer’s turbine installed in your handpiece. Manufacturers reserve the right to void your warranty if you are not using their brand of lubricant. Once your handpiece is out of the warranty period, or if you choose a different source for handpiece repair than the original manufacturer, then you are free to use any lubricant you wish. There are a myriad of choices on the market, sporting all sorts of claims. Some are advertised as a cleaner and lubricant in one, some are synthetic, and some advocate the use of a separate cleaner and oil. That you consistently employ a good-quality oil matters more than which brand of oil you choose.

Automatic Lubrication Stations

Many manufacturers offer an automatic clean and lube station to minimize staff time and take the guesswork out of the maintenance process. These units vary in cost, depending on features. One incentive to purchase an automatic lubrication station would be that some manufacturers will significantly extend their handpiece warranties if their respective automatic stations are used to maintain the handpieces.

Figure 18. Lubrication stations



The simplest lubricator design holds only one handpiece, and the operator must remain at the station to hold the button down during the entire process. This ensures a complete cycle of lubrication and flushing, but there is no time savings for staff. Fully automatic designs will hold more than one handpiece, including low-speed attachments. Similar to using an autoclave, the operator loads the machine, closes the door, and presses a button. This begins the maintenance cycle, and the machine will dispense the correct amount of lubricant and then operate each handpiece at the correct running speed. During operation the staff member is free to complete other duties while the machine runs multiple handpieces through the maintenance cycle. While the automatic machines initially cost more, there is absolute consistency of operation, which may result in longer handpiece life and reduced repair costs. Additional savings may accrue while the staff member completes normal between-patient tasks and does not need to use valuable time performing routine handpiece maintenance procedures. One area of concern that is not often addressed is chuck maintenance. According to a handpiece manufacturer product manager, "Ninety-five percent of all turbine or attachment problems are found in the head of the handpiece. Everyone always seems to lubricate the back end, maybe purge, but do not address the head of the handpiece or the chuck."¹⁵ When a handpiece is in operation, the air is being expelled outward. Once the clinician takes his or her foot off the rheostat the physics reverse, which can bring contaminants and tooth dust back into the head of the handpiece. If these particles are not purged, they bake onto the internal components and will cause premature failure. By shooting lubricant and compressed air into the chuck, this will help dislodge the debris or at least loosen it up. Once you run a purge cycle by attaching it to the tubing or maintenance system, the particles are much more likely to be expelled from the handpiece, extending longevity.

Common Handpiece Maintenance Mistakes

There are a number of common maintenance mistakes that should be avoided:

1. Using a chemical wipe-down on a handpiece before sterilizing: this is not only redundant, it may multiply harmful reactions when the handpiece is subjected to heat.
2. Using an ultrasonic cleaner or solution: except for immersion in a cleaning solution offered by the handpiece manufacturer, handpieces should never be immersed in any fluids.
3. Lubricating in the wrong hole – The drive air line leads directly to the turbine; other orifices such as exhaust and water do not. If you are using a liquid oil applicator on a swivel-type handpiece, it is critical that you deliver oil to the correct internal opening.
4. Using an incorrect lube applicator – Make sure the spray tip fits the handpiece quick-disconnect correctly.

Some models depend on a pressurized fit to flush out debris.

5. Not applying enough lubricant – Sometimes the staff is directed not to overspray oil into the handpiece, to reduce excess residue; however, it is important to ensure that oil is getting to the bearings, by seeing oil leave the head.
6. Not running the handpiece prior to autoclaving – Failing to operate the handpiece following lubrication will gum up the turbine as excess oil gets baked into the bearings; an undesirable clinical effect is expelling oil into the operating field after not properly running out the excess.
7. Not cleaning the fiber-optic bundles – Failing to keep the fiber-optic bundle surfaces clean will lead to a buildup of oil and debris, affecting the ability to transmit light.
8. Leaving the bur in the chuck during autoclaving – When a bur is held in an autochuck, the springs are compressed. Subjecting any spring to heat and corrosion under tension will weaken it and shorten the life. Leaving a bur in a manual chuck leads to buildup of debris in the chuck and increased difficulty of operation.
9. Leaving levers open during autoclaving – When a lever chuck is actuated, about eight pounds of force is exerted onto the front O-ring of the turbine. During normal operation this force is momentary as the bur is changed. Leaving the chuck open during the autoclave cycle means compressing the O-ring while subjecting it to heat for 30 minutes. This will dramatically accelerate turbine failure.
10. Failing to maintain autoclaves – If the autoclave is not properly cleaned, buildup can occur that contaminates the entire system, including the handpieces.

Handpiece Repair Options

Historically, the most conventional method of restoring a handpiece to service was to replace the old turbine with a new one. With replacement intervals measured in years, cost was no great concern. As the rate of repair increased once handpieces required sterilization, cost became a consideration. Options available for handpiece repair include replacing or rebuilding the turbine, either doing this in-office or sending the handpiece to the original equipment manufacturer or an independent repair service.

Turbine Replacement

Handpiece turbine repair options include returning the handpiece to the original equipment manufacturer, purchasing a new turbine from the original manufacturer and installing it yourself, or purchasing a new "aftermarket" or generic turbine and installing it yourself. Before 1992, standard procedure was simply to order a new turbine from the original manufacturer or send the handpiece back to the manufacturer for repair (who may or may not charge a significant labor fee for installing a new turbine).

In-Office Turbine Replacement

Staff can replace some models in the office, or a sales rep or service technician could offer help if needed. In this situation, buying a turbine from the company that built your handpiece guarantees continued quality and consistency. One advantage of purchasing a new original turbine is the warranty. Handpiece manufacturers offer warranties on their in-house repairs as well as on new turbines ranging from six months to one year, two years or more if their respective automatic maintenance stations are used to process handpieces for sterilization.

Installing original turbines in the office preserves all the performance characteristics that influenced the purchase of that brand in the first place and reduces the cost of replacement. It also eliminates the need for the handpiece to leave your office, reducing turnaround time associated with sending handpieces back to a manufacturer. This option still represents a major expense, and some models may be complicated to install. Your local dental supply rep can demonstrate proper installation techniques, or you can request a visit from the manufacturer's representative to go over maintenance and turbine replacement.

Another option for handpiece repair is to install aftermarket replacement turbines. These are turbines produced by anyone other than the original handpiece manufacturer. Aftermarket (generic) turbines can be as little as one-third the cost of a new original turbine. However, although they are less expensive, the quality of aftermarket turbines varies depending on the source. Some bearing manufacturers that supply parts to handpiece manufacturers also market high quality turbines directly to handpiece repair facilities as well as dentists. In contrast, some other sources market poor quality aftermarket turbines that can result in poor handpiece performance; more frequent breakdown; a cycle of disposability; and greater cost over time than either replacing the failed original turbine with a new original turbine or rebuilding the original turbine in the first place. Be sure if you decide to purchase aftermarket turbines that these are of high quality and that you are purchasing them from a trusted, reliable source.

Turbine Repair/Rebuild

Rebuilding a turbine instead of replacing it saves money. As handpiece repair costs escalated, dentists increasingly turned to local independent repair services to extend turbine life, by rebuilding as opposed to replacing turbines. Turbine rebuilding services have earned greater acceptance throughout the dental industry over the years. According to a December 2003 survey of "workhorse systems" by *Dental Products Report*, 59 percent of dentists employ a dedicated handpiece repair shop to maintain their handpieces.¹⁶ One handpiece manufacturer has now adopted this lower-cost option when they have to replace a turbine under warranty. At a high-quality independent repair service, a technician will evaluate the turbine to

determine if the key component parts remain usable and safe. A turbine can be rebuilt effectively (vs. buying a whole new turbine) if the spindle/chuck assembly is not worn enough to degrade performance. The technician will replace the damaged bearings and supporting O-rings with new ones meeting factory specifications. Rebuilding a turbine properly consists of carefully removing the broken bearings without damaging the rest of the assembly. New bearings are then pressed onto the spindle/chuck assembly. The suspension O-rings are critical to handpiece performance and are replaced as well. Independent studies cited earlier confirm that it is usually only the bearings that fail. As long as the remaining components are still serviceable, total replacement is unnecessary.

Figure 19. Turbine assembled and unassembled



The price for rebuilding a turbine is usually around \$100 – substantially lower than the cost of a new original manufacturer replacement turbine. Warranties offered on rebuilt turbines range from three months to one year, depending on handpiece models and the experience and ability of the technician. Most repair services offer relatively fast turnaround, minimizing downtime and eliminating the need to own extra handpieces. The major disadvantages of independent repair services are that everything depends on the individual skill and experience of the technician performing the work as well as access to the right repair parts and specialty tooling; these can vary widely among services. There are no uniform standards of practice, and no certifying body exists within the industry. One solution is to find a repair facility that has technicians certified by a handpiece manufacturer, or that at least has a relationship with handpiece manufacturers, and the ability to offer original replacement parts. Handpiece manufacturers do not distribute high-speed turbine component parts; they sell only complete assemblies. How then can independent repair shops obtain original parts? Higher-quality repair shops are able to purchase directly from the component parts manufacturer. It takes knowledge, experience, and a willingness to do what is best for the customer for an independent repair service to make the extra effort to obtain the correct original parts.

Some dentists decide to rebuild their turbines in the dental office using a commercially available do-it-yourself process. This approach may be acceptable for simpler designs but risks damaging more sophisticated turbine assemblies. Quality of parts selected may be a concern, depending on the source, and the skill and attention to detail of the repairer in the dental office can vary substantially.

Evaluating Claims Made by the Handpiece Industry

Very few companies are able to produce the miniature precision bearings capable of performing under the tremendous speeds required by dentistry and of withstanding harsh sterilization conditions. The current CDC guidelines recommend autoclaving of dental handpieces after use for a single patient.¹⁷ Due to the highly specialized nature of precision bearing production, dental handpiece manufacturers purchase bearings and other components from only a limited number of suppliers. Exact specification dental bearings and other parts are available to independent repair services from these same bearing manufacturers.

Quality ratings for bearings are established by the Annular Bearing Engineering Committee (ABEC) of the American Bearing Manufacturers Association. Quality is rated on the ABEC scale from 1 to 9. For example, rollerblade skate bearings are ABEC 3. The dental industry standard begins at ABEC 7. A plethora of bearing designs and specifications are available for handpiece repair. Using cheap or incorrect bearings is one reason why repair quality varies so much from shop to shop. If the technician is not installing a bearing as good as that originally specified by the manufacturer, handpiece performance will suffer. A quality repair shop should know which bearing is specified by the handpiece manufacturer and should be using only the correct bearings as replacements.

Factors to Consider When Choosing a Handpiece Repair Service

Deciding where to turn to for handpiece repair can be challenging. Cost and turnaround time are major considerations that may result in a dental office selecting an option other than returning the handpiece to the original equipment manufacturer outside of warranty period. On the other hand, if a handpiece repair service is selected, care must be taken to select one that will not result in poor quality instead of higher cost – ultimately, poor quality leads to high cost, too, and major inconvenience. If selecting a repair service, considerations include the following:

- 1. Training:** Make sure your service provider has made a significant investment in training and equipment and takes continuing education courses to remain current on new products and techniques. Simply attending a weekend seminar or watching a video is not enough. Without adequate training, even a well-meaning person will produce poor results and possibly damage your handpiece.
- 2. Make sure repairs are performed in-house:** If a repair service simply acts as a middleman for a repair facility elsewhere, you may experience a lack of quality control, longer turnaround times, and limited customer service.
- 3. Use of genuine manufacturer turbines:** Some repair services replace the dentist's original turbine with an inferior generic replacement without informing the

dentist of the substitution. This is unethical. A handpiece is a sophisticated device and can easily be compromised with improper techniques and inferior parts. Watch out for nebulous claims such as “same as manufacturer's specifications” or “manufacturer-quality parts.” There should be no room for interpretation. If a repair shop claims to supply original turbines, then original packaging and instructions should accompany these installations.

- 4. Relationship with the repair service:** The best service results from dealing directly with the technician who performs the repair, not with customer service or voicemail. Dental professionals need to establish a trusting relationship with someone who can easily articulate exactly what services are being provided.
- 5. Obtaining estimates:** Repair options and costs should be spelled out clearly. Communication is vital in order for you to be sure you are receiving exactly what you are paying for. Be wary of companies that do not provide published pricing and of repair contracts promising to service handpieces for a fixed fee (which result in an incentive to replace as few parts as possible instead of performing a complete overhaul of the turbine if required). Some companies offer “clean and lube” services at prices up to \$45. This can be done in the office by the staff instead, at no cost and until a high-speed handpiece actually fails, daily staff maintenance is all that is required to prolong its life.
- 6. Get a warranty:** A quality repair operation should provide a substantial warranty on all repairs. Another indicator of a qualified service is the ability to facilitate and provide original factory repairs if these are necessary (not all handpiece repairs can be performed correctly in the field).
- 7. Honest advice and commitment:** An ethical service provider should inform the office when total replacement makes more sense. A good repair service holds a sincere interest in serving the needs of dental professionals and should be committed to improving the overall industry. Look for a company that belongs to a trade association and supports local dental society meetings and events.

Summary

Handpieces are one of the most important workhorse systems in the dental practice and require routine autoclaving, yet they have an often undeserved reputation for excessive breakdown and expense. If you maintain your handpieces properly, you will get many years of optimal performance; and, when the time comes to repair your handpiece, consideration should be given to the quality of the repair and reliability of a qualified service provider to restore your workhorse to optimal performance. The bottom line is that handpieces represent a significant investment and play a vital role in any dental practice.

References:

- 1 Ring ME. The true discoverer of the dental air turbine handpiece, Sir John Walsh of New Zealand. *Bull Hist Dent*. 1987 Oct;35(2):106-9.
- 2 http://www.dentalproductsreport.com/articles/show/dpr0709_pf_handpieces
- 3 Lewis DL, Boe RK. Cross-infection risks associated with current procedures for using high-speed dental handpieces. *J Clin Microbiol*. 1992 Feb;30(2):401-6.
- 4 Breo DL. Meet Kimberly Bergalis--the patient in the 'dental AIDS case'. *JAMA*. 1990 Oct 17;264(15):2018-9.
- 5 FDA Guideline to Dentists, September 28, 1992.
- 6 CDC/FDA Medical Bulletin – March 1993.
- 7 Electric Handpiece Systems. ADA Professional Product Review, vol. 2, issue 1.
- 8 Choi C, Driscoll CF, Romberg E. Comparison of cutting efficiencies between electric and air-turbine dental handpieces. *J Prosthet Dent*. 2010 Feb;103(2):101-7.
- 9 Available at: <http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm226995.htm>
- 10 Leonard DL, Charlton DG. Performance of High-Speed Dental Handpieces Subjected to Simulated Clinical Use and Sterilization. *J Am Dent Assoc*. 1999;130(9):1301-11.
- 11 Advancements in Handpieces – 10 Years After Sterilization. *Clinical Research Associates Newsletter*, October 2000.
- 12 Dyson JE, Darvell BW. Flow and free running speed characterization of dental air turbine handpieces. *J Dent*. 1999 Sep;27(7):465-77.
- 13 ISO Standard 7785-1, Dental Handpieces, International Standards Organization, 1992.
- 14 Monaghan DM, Wilson NH, Darvell BW. The performance of

air-turbine handpieces in general dental practice. *Oper Dent*. 2005 Jan-Feb;30(1):16-25.

- 15 Personal Communication. Eric Ozelski, Product Manager for SciCan.
- 16 Survey of Workhorse Systems. *Dental Products Report*, December 2003.
- 17 Centers for Disease Control and Prevention. Guideline for disinfection and sterilization in healthcare facilities, 2008. Available at: http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/Disinfection_Nov_2008.pdf. Accessed December 8, 2008.

Author Profile



Glenn Williams, BS

Glenn Williams is a twenty-five year veteran of the dental industry, specializing in handpieces since 1987. From 1987-1994, Glenn worked for a major handpiece manufacturer. He has owned and operated a successful handpiece repair service in Northern California since 1994. Glenn was one of the founding members, and is President,

of the National Dental Handpiece Repair Association. The NDHRA is an association of other dedicated independent handpiece professionals who desire to better serve the dental profession through advancing the handpiece repair industry by establishing and maintaining high standards of service.

Disclaimer

The author of this course owns and operates an independent repair service and is the President of the National Dental Handpiece Repair Association.

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Questions

1. Pioneering work for the air-driven high-speed handpiece was performed by _____.
 - a. Sir John Nash
 - b. Sir James Black
 - c. Sir James Walsh
 - d. Sir John Walsh
2. Increased concentricity results in _____.
 - a. a smoother cut
 - b. better margins
 - c. less vibration
 - d. all of the above
3. Most of what we now take for granted as "restorative dentistry" was made possible because of the advancing technology of the _____.
 - a. hybrid handpiece
 - b. air-driven handpiece
 - c. electric handpiece
 - d. all of the above
4. Automatic chucking mechanisms were developed in an effort to _____.
 - a. speed up the changing of burs
 - b. speed up the removal of debris
 - c. automate bur rotational speed adjustment
 - d. a and c
5. Tubing torque is defined as the _____ the operator feels from the weight of the tubing transferred through the handpiece.
 - a. resistance or drag
 - b. rotation
 - c. pressure
 - d. all of the above
6. The FDA issued the first guidelines mandating routine handpiece sterilization for private dental practices in the _____.
 - a. 1960s
 - b. 1970s
 - c. 1980s
 - d. 1990s
7. The clinician should apply careful consideration to the _____ of a particular handpiece model when making a purchase decision.
 - a. features
 - b. reliability
 - c. maintenance requirements
 - d. all of the above
8. A small head size in a handpiece _____.
 - a. improves visibility
 - b. improves access
 - c. improves seizing
 - d. a and b
9. Larger head sizes in handpieces _____.
 - a. incorporate a larger turbine impeller
 - b. yield higher power output
 - c. result in less time involved in tooth preparation
 - d. all of the above
10. The typical handpiece head is angled back at _____.
 - a. 12.5 degrees
 - b. 17.5 degrees
 - c. 22.5 degrees
 - d. 27.5 degrees
11. In recent years, newer handpiece models have become available, operating in a range of _____.
 - a. 38 to 51 decibels
 - b. 48 to 61 decibels
 - c. 58 to 71 decibels
 - d. none of the above
12. A handpiece with a wider, flared body shape toward the rear of the handpiece _____.
 - a. reduces the pinching force required to grip the handpiece
 - b. reduces hand fatigue
 - c. reduces wrist fatigue
 - d. all of the above
13. An electric handpiece _____.
 - a. is louder than an air-driven high-speed handpiece
 - b. has differences between freerunning speed and active speed
 - c. loses power while cutting tooth structure
 - d. none of the above
14. Fiber optics and multiport water spray are available in _____.
 - a. electric handpiece attachments
 - b. air abrasion units
 - c. high-speed air-driven handpieces
 - d. a and c
15. The most commonly used electric handpiece attachment for operative dentistry is a _____.
 - a. 1:3 step-up
 - b. 1:5 step-up
 - c. 1:7 step-up
 - d. any of the above

Questions (Continued)

16. It is imperative that you stop using an electric handpiece immediately if you _____.
- feel any heat during use
 - hear any noise during use
 - notice any reduction in vibration
 - all of the above
17. Handpiece life expectancy dropped dramatically during the 1990s due to _____.
- contamination with bacteria
 - repeated sterilization
 - debris entering the handpiece
 - all of the above
18. _____ is a variable that affects turbine life.
- Lubrication
 - Conditions of use
 - Maintenance practices of the individual office
 - All of the above
19. In one study, DIS concluded that the dentist can expect a handpiece to survive approximately _____ sterilization cycles without significantly reduced performance, if the handpiece is properly maintained.
- 250
 - 500
 - 750
 - none of the above
20. An air-driven high-speed handpiece consists of two main components: the _____.
- body and the turbine
 - turbine and the impeller
 - body and the spindle
 - body and the outlet
21. The current state-of-the-art in handpiece construction is _____.
- titanium
 - stainless steel
 - brass
 - none of the above
22. Manufacturers claim that virtually no degradation occurs with _____ optics and back their claims with a five-year warranty.
- glass fiber
 - cellular
 - chip
 - all of the above
23. A major problem associated with handpiece sterilization is the continual buildup of _____.
- bacterial debris
 - rust and corrosion
 - lysed sterilization products
 - all of the above
24. The latest handpiece models feature a multi-port water spray that _____.
- disperses air and water evenly around the work area
 - disperses lubrication and water evenly around the work area
 - disperses water evenly around the work area
 - all of the above
25. The component that fails most often on a high-speed air-driven handpiece is the _____.
- impeller
 - turbine
 - chuck
 - none of the above
26. Turbines rotate at speeds ranging from _____.
- 180,000 to 250,000 rpm
 - 280,000 to 350,000 rpm
 - 380,000 to 450,000 rpm
 - none of the above
27. Free speed is the maximum rpm with _____.
- no load
 - load
 - activation
 - a and c
28. As the turbine bearings wear, speed decreases and results in _____.
- longer preparation times
 - slower cutting
 - rougher margins
 - all of the above
29. The more concentrically a handpiece operates, the _____.
- smoother the bur cuts
 - less perceptible vibration is
 - more comfort patients experience
 - all of the above
30. A high-speed turbine contains _____.
- a chucking mechanism
 - a vibratory system
 - a rotary system
 - a and c
31. Handpieces fail as a result of catastrophic failure of the _____.
- chuck
 - spindle
 - turbine bearings
 - all of the above
32. The retainer, or cage, that secures the ball bearings within the raceways _____.
- becomes brittle as it is subjected to harsh sterilization environments
 - disintegrates upon failure
 - becomes eccentric after 200 cycles
 - a and b
33. _____ is a symptom of bearing failure.
- The bur stalling out when applied to tooth structure
 - Unacceptable vibration when the handpiece is activated
 - Unusually loud sounds emanating from the turbine
 - all of the above
34. _____ can have an impact on turbine life.
- Overusing dull burs
 - Long cutting burs
 - Incorrect bur seating in the autochuck
 - all of the above
35. Prior to removing a handpiece from the air line, CDC guidelines call for flushing _____ through the handpiece in the operatory for _____.
- ethanol; 20 seconds
 - ethanol; 30 seconds
 - water; 20 seconds
 - water; 30 seconds
36. After lubrication, it is important to _____.
- run the handpiece to evenly distribute oil through the bearings and chuck mechanism
 - avoid running the handpiece prior to sterilization
 - ensure excess oil is present to allow for waste
 - a and c
37. A flush station _____.
- eliminates a return trip to the operatory to run the handpiece
 - requires only a connection to compressed air
 - prevents oil from being exhausted back into the handpiece tubing
 - all of the above
38. After autoclaving a handpiece, _____.
- the handpiece may be removed halfway through the dry cycle
 - the packaging must be completely dry before it is removed from the autoclave
 - the handpiece should be sprayed with disinfectant to maintain sterility
 - a and c
39. Dental motors and attachments require _____ than a high-speed spray.
- higher viscosity oil
 - lower viscosity oil
 - silanized oil
 - b and c
40. Using a chemical wipe-down on a handpiece before sterilizing _____.
- is redundant
 - is necessary
 - may multiply harmful reactions when the handpiece is subjected to heat
 - a and c
41. Handpiece turbine replacement options include _____.
- returning the handpiece to the original equipment manufacturer
 - purchasing a new turbine from the original manufacturer and installing it yourself
 - purchasing a new "aftermarket" or generic turbine and installing it yourself
 - all of the above
42. Installing original turbines in the office _____.
- preserves the performance characteristics of the handpiece
 - reduces the cost of replacement
 - eliminates the need for the handpiece to leave your office
 - all of the above
43. Rebuilding a turbine properly consists of _____.
- carefully removing the broken bearings without damaging the rest of the assembly
 - pressing new bearings onto the spindle/chuck assembly
 - replacing the suspension O-rings
 - all of the above
44. If you select an independent handpiece repair service, it is important to _____.
- get a warranty
 - ensure the technician has adequate training
 - make sure the repair service is using the correct bearings
 - all of the above
45. Until a high-speed handpiece actually fails, _____ is all that is required to prolong its life.
- daily maintenance by staff
 - weekly servicing
 - monthly check-ups by the handpiece technician
 - all of the above
46. Failing to keep the fiber-optic bundle surfaces clean will _____.
- lead to a buildup of oil
 - lead to a buildup of debris
 - affect the ability to transmit light
 - all of the above
47. Quality ratings for bearings are established by the _____.
- Annular Bearing Engineering Council
 - American Bearing Association
 - Annular Bearing Engineering Committee
 - none of the above
48. The dental industry for bearings begins at _____.
- ABEC 3
 - ABEC 5
 - ABEC 7
 - ABEC 9
49. According to a 2003 survey, _____ of dentists employ a dedicated handpiece repair shop to maintain their handpieces.
- 49 percent
 - 59 percent
 - 69 percent
 - none of the above
50. An aftermarket turbine is one that is produced by _____.
- your local dental assisting school on request
 - anyone other than the original handpiece manufacturer
 - the original handpiece manufacturer
 - all of the above

Anatomy of a Handpiece: Understanding Handpiece Maintenance and Repairs

Name: _____ Title: _____ Specialty: _____
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Educational Objectives

- List and describe the major components of air-driven high-speed handpieces and electric handpieces.
- List and describe the major differences between air-driven high-speed handpieces and electric handpieces.
- List and describe the signs of failure for air-driven and electric handpieces.
- List and describe the maintenance steps for air-driven handpieces.
- List and describe the options for repair/rebuild of air-driven handpieces and considerations in selecting from these options.

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1. Were the individual course objectives met?	Objective #1: Yes No	Objective #3: Yes No
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	Objective #5: Yes No	
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3. Please rate your personal mastery of the course objectives.	5 4 3 2 1 0	
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| 13. (A) (B) (C) (D) | 38. (A) (B) (C) (D) |
| 14. (A) (B) (C) (D) | 39. (A) (B) (C) (D) |
| 15. (A) (B) (C) (D) | 40. (A) (B) (C) (D) |
| 16. (A) (B) (C) (D) | 41. (A) (B) (C) (D) |
| 17. (A) (B) (C) (D) | 42. (A) (B) (C) (D) |
| 18. (A) (B) (C) (D) | 43. (A) (B) (C) (D) |
| 19. (A) (B) (C) (D) | 44. (A) (B) (C) (D) |
| 20. (A) (B) (C) (D) | 45. (A) (B) (C) (D) |
| 21. (A) (B) (C) (D) | 46. (A) (B) (C) (D) |
| 22. (A) (B) (C) (D) | 47. (A) (B) (C) (D) |
| 23. (A) (B) (C) (D) | 48. (A) (B) (C) (D) |
| 24. (A) (B) (C) (D) | 49. (A) (B) (C) (D) |
| 25. (A) (B) (C) (D) | 50. (A) (B) (C) (D) |

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PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.

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