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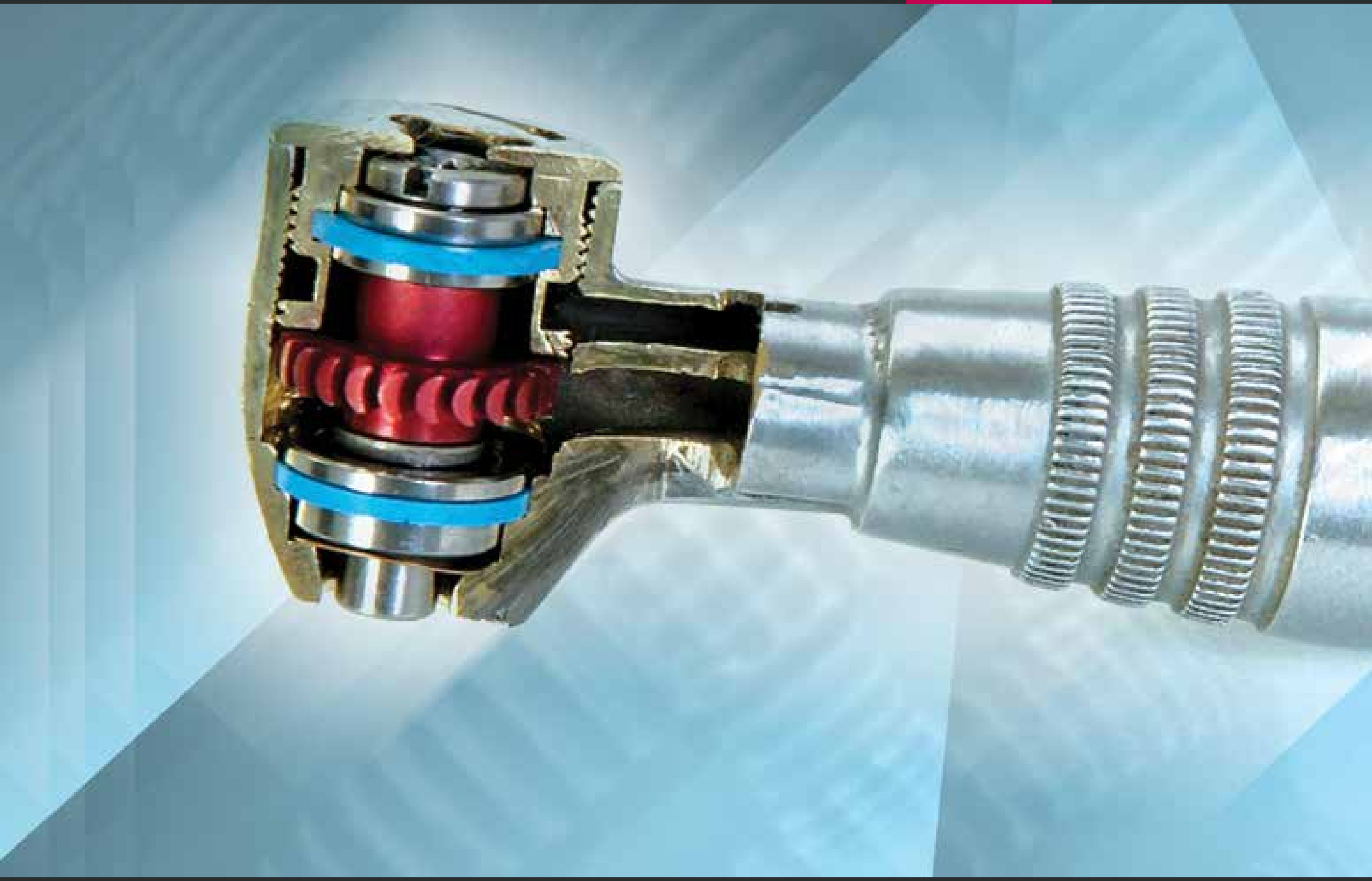

Anatomy of a handpiece: Understanding handpiece maintenance and repairs

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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.

EDUCATIONAL OBJECTIVES

At the conclusion of this educational activity, participants will be able to:

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.

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INTRODUCTION

The dental handpiece of today is a sophisticated combination of precision parts moving in perfect synchronization at extremely high speed. Handpieces have evolved significantly since the original models of the 1950s (figure 1).

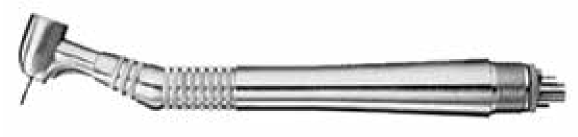

Figure 1: First-generation air-driven high-speed handpiece

In the 1970s, advancing technology of the air-driven handpiece provided smoother preparations at higher speeds and reduced vibration (figure 2). This is responsible for many conveniences we take for granted today, including sit-down dentistry, four-handed dentistry, reclining patient chairs, and multiple simultaneous patient appointments.

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

EVOLVING HANDPIECE TECHNOLOGY

In the 1980s, 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 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, or resistance from the tubing to the operator's hand. Most swivels were designed as quick disconnects, which facilitated the removal of the handpiece for *daily* lubrication.

In 1992, handpiece maintenance changed dramatically as a report was published, based on laboratory studies, recommending routine heat-treatment of dental handpieces.[1] Shortly prior to this, a woman in Florida became infected with the AIDS virus[2] and news media sources highlighted her dentist's office as the source of infection. In 1993, the FDA issued the first guidelines mandating routine handpiece sterilization for private dental practices.[3,4] As a result, longevity of handpieces declined, requiring clinicians to consider many factors when selecting a dental handpiece.

CRITERIA FOR SELECTING AIR-DRIVEN HIGH-SPEED HANDPIECES FOR CLINICAL USE

Clinicians should apply careful consideration to the cost, features, reliability, and maintenance requirements prior to finalizing a purchase. It is suggested to request a demonstration unit to ensure satisfaction as FDA regulations prohibit handpiece manufacturers from accepting opened products back from customers not satisfied with their purchases. The following list of criteria may serve as a useful guide when selecting a new air-driven handpiece system (figure 3).

Figure 3: Handpiece head sizes

Head size and angulation: Historically, there has been a natural trade-off between head size and cutting power. A small head size improves visibility and access, while larger head sizes yield higher power output. Head angulation is another feature to consider. The typical handpiece head is angled 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.

A recent innovation to enable decreased head size is the use of smaller diameter balls in the high-speed dental bearing itself. NSK has developed its own proprietary ball bearings using a .8 mm ball, instead of the industry standard 1 mm ball size. The benefits for reducing ball size includes improved durability and a smaller head size. See Figure 4 for an illustration of handpiece head sizes.

Figure 4: Air-driven high-speed handpieces

Sound level: Elevated handpiece noise levels can cause hearing loss in dental professionals and discomfort and increased anxiety in patients. Sound levels are associated with air flow through the handpiece head and newer handpiece models with lower noise levels have become available, operating in a range of 58-71 decibels (dB).

Ergonomic design: The cumulative strain from holding a handpiece can result in long-term health issues in the form of carpal tunnel syndrome. Different handpiece models can vary significantly in length, weight, and balance. The most reliable way to determine the best fit and feel for your hand is to actually use the handpiece in your practice. 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.

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. The number of spray ports incorporated into the handpiece face can be as high as five; however, three and four ports are the most common configurations on the market. Many handpiece manufacturers are designing an inline water microfilter into the body of the handpiece to reduce downstream clogging of the tiny water ports. When the filter becomes too clogged for use, it can easily be removed and cleaned or replaced.

Illumination: Fiber optics enhance operator visibility by projecting light through the handpiece to illuminate the operating field directly around the bur. Glass fibers were extruded into the handpiece and held together with adhesives. These adhesives degrade under the stress of autoclaving, leading to gradual loss of light transmission over time. To prevent this degradation, cellular optics made from solid glass rods were introduced. Cellular optics will not degrade and carry warranties of up to five years. The next improvement in light production was moving to an LED lightbulb that generates a brighter, whiter light. Most existing fiber-optic systems can be upgraded to work with an LED lightbulb. Recent innovations in dental handpiece lighting involve an internal generator inside the handpiece body. The drive air turns a small turbine that powers an LED. This is revolutionary because it eliminates the need for the expensive fiber-optic system with wires and transformers. A clinician can literally screw this type of handpiece on any handpiece tubing and create instant bright LED light.

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. Almost every handpiece manufacturer exclusively uses silicon nitride ceramic balls for all new products. 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 most outstanding 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. Electric handpieces are significantly quieter than air-driven handpieces. 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.[5]

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 dial in the exact speed at which he or she would like the bur to rotate.

Any number of universal 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. All electric 1:5 high-speed attachments can be easily identified by a color-coded red ring around the base. 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. Although there are exceptions, electric attachments are generally universal, meaning that any brand will work with any motor.

Electric handpieces have been found to be heavier, yet more efficient than air-driven, high-speed handpieces.[6] Many users report that reduced cutting time offsets any challenges with the size and weight of the handpiece. Head size is also typically larger than the average high-speed, air-driven handpiece; however, recent models feature an extremely small head size: less than 9 mm in diameter, actually smaller than many air-driven high speeds. Electric handpieces are a greater investment than air-driven and

Figure 5: Internal working of an electric handpiece

there are additional costs for each attachment. Moreover, electric handpieces consist of several complex parts; this intricate array of gears and bearings makes repair more costly than for air-driven, high-speed handpieces (figure 5).

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. In 2010, the FDA issued a second safety alert regarding reports of serious patient tissue damage due to overheated electric attachments during dental treatment procedures.[7] A simple procedure to check for heat is to lightly touch the push-button cap of the handpiece at each stage of a procedure when changing burs. This simple precaution will prevent patient injury and will also reduce the cost of repair by not causing further damage to internal parts. It is imperative that you stop using an electric handpiece immediately if heat is detected during use.

A HYBRID AIR-ELECTRIC HANDPIECE

In 2010, Midwest Dental introduced a hybrid system, the Stylus ATC, that uses 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 (figure 6). This constant speed delivers the same torque as an electric handpiece. 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. After a decade being unchallenged in this space, Adec has now introduced the Primea hybrid type handpiece. Only available as a built-in feature on their advanced delivery unit, the handpiece contains a sensor in the head that constantly measures the rotational speed of the bur and sends a signal to adjust the air supply to maintain a constant amount of torque to the cutting instrument.

ROUTINE STERILIZATION OF HANDPIECES

Handpiece life expectancy drops and need for service and repair increase dramatically due to the stresses of repeated sterilization; handpieces now show signs of extreme wear within a year or less. It is difficult to quantify life expectancy under sterilization conditions because of the tremendous number of variables associated with turbine life; however, a handpiece can reliably survive approximately 500 sterilization cycles, or approximately 1 year of clinical use before performance is reduced.[8,9]

Figure 6: Torque control unit

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% lighter than stainless steel and stronger and more resistant to the corrosive effects of autoclaving (figure 7).

Figure 7: A body or shell before (top) and after (bottom) the corrosive effects of sterilization over time

The body (shell) of most handpieces is comprised of 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 push-button-type bur changing. The joint between the head and body can loosen, and the head can become too dented and affect the turbine operation.

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 corrosion that naturally occurs in the steam-saturated environment of the autoclave. Internal corrosive buildup gradually closes off the handpiece exhaust ports, leading to increased back pressure around the turbine, resulting 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 multiport 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 8).

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.[10] 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, defined as "work or energy divided by time," is the measurement of the handpiece's ability to remove tooth structure and is expressed as watts of energy, which is joules/seconds. Handpieces once generated 10 to 13 watts, while newer handpiece models produce 15 to 23 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. Another measurement of a handpiece's performance is known as torque, and can be defined as "a twisting force that causes rotation." Torque is expressed as units of ounce/inch and measures the rotational force on the movement of the bur.

Concentricity can be defined as the ability of the handpiece to produce a cut line 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) specifications[11] 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. 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 is potentially very dangerous.

As the only moving part inside a high-speed handpiece, the turbine is the most common source of problems. Problems that can be identified clinically include degradation of the bearings within the turbine, evidenced when "black stuff" is expelled from the handpiece head during use or lubrication procedures (figure 9). 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.[12]

Figure 8: High-speed turbine before (left) and after (right) the effects of wear and sterilization

Figure 9: Bearing retainers showing stages of degradation

PROLONGING HANDPIECE LIFE THROUGH PROPER USE AND MAINTENANCE

Handpiece life can be substantially elongated by understanding the importance of variables that can be controlled within the practice and by 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

Table 1: General maintenance procedures

High-speed handpieces

1. Surface clean the handpiece

- Prior to removing a handpiece from the air line, CDC guidelines[13] call for flushing water through the handpiece in the operatory for 30 seconds to remove potential contaminants from the internal water line.
- Then use a brush under running water to remove any bioburden 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.[14]

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 for 20 seconds to evenly distribute oil through the bearings and chuck mechanism and to expel excess oil to prevent coagulation during autoclaving.
- Refer to each manufacturer's instructions for use regarding the necessity to run the handpiece with a bur in the chuck.

5. Clean fiber-optic surfaces

- Alcohol and a cotton bud 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.

Notes on air-driven, low-speed motors and attachments (figure 10)

Cleaning

- Perform an external cleaning with a brush under running water prior to bagging the sheath or nose cone for sterilization.[15]

Sterilization

- The CDC Statement on Reprocessing Dental Handpieces indicates that "all handpieces and other intraoral instruments that can be removed from the air lines and water lines of dental units" be heat sterilized. If a dental handpiece cannot be heat sterilized, it should not be used.

Lubrication

- 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 is suggested (figure 11). Run the motor to distribute the oil. Also apply some oil as a preventive 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.

Latch angles

- Latch angles require specific care. If angles are routinely used, unscrew the head (figure 12) from the sheath and remove the transmission gear for cleaning and oiling on a daily basis. 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.

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. Obviously, 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 use a handpiece less often and with less force.

Figure 10: Low-speed attachments

Figure 11: Proper lubrication of handpiece

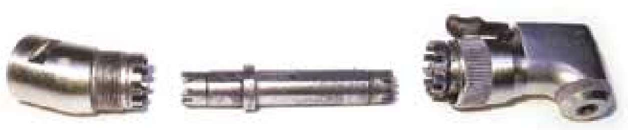

Figure 12: Latch head components

HANDPIECE LUBRICANTS

Follow the manufacturer's suggested maintenance procedures, including the use of approved lubricants to avoid any disputed warranty claims should your handpiece or turbine fail under warranty. Manufacturers reserve the right to void your warranty if you are not using recommended lubricant. While it is suggested to use the lubricant recommended by the manufacturer, there are many lubricants commercially available; some are advertised as a cleaner and lubricant in one, some are synthetic, and some advocate the use of a separate cleaner and oil. The consistent use of a good-quality oil matters more than which brand of oil you choose.[16]

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 (figure 13). 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. Additionally, automatic

Table 2: Common handpiece maintenance mistakes

Wiping down with a chemical before sterilization
This is not only redundant, but harmful reactions can occur when the handpiece is subjected to heat.

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.

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.

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.

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.

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.

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.

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.

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.

Failing to maintain autoclaves
If the autoclave is not properly cleaned, buildup can occur that contaminates the entire system, including the handpieces.

Figure 13: Lubrication stations

lubrication stations will dispense the correct amount of lubricant, run each handpiece at the correct speed, and provide a more consistent maintenance procedure.

One area that should not be overlooked 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 does not address the head of the handpiece or the chuck."[17] When a handpiece is in operation, the air is being expelled outward. Once the clinician removes their foot from 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. Applying lubricant and compressed air into the chuck will minimally loosen or dislodge debris. Running a purge cycle by attaching the handpiece to the tubing or maintenance system, particles are much more likely to be expelled, extending longevity.

HANDPIECE REPAIR OPTIONS

Turbine replacement

Handpiece turbine repair options include returning the handpiece to the original equipment manufacturer, purchasing a new

Figure 14: Turbine assembled and unassembled

turbine from the original manufacturer and installing it yourself, or purchasing a new "aftermarket" or generic turbine and installing it yourself.

In-office turbine replacement

Staff, a sales rep, or a service technician can replace some models in the office. 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 and may extend the warranty 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.

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. 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 (figure 14) instead of replacing it saves money. 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% of dentists employ a dedicated handpiece repair shop to maintain their handpieces.[18] A more recent study conducted by Clinicians Report surveyed 1,025 dentists and found that the local handpiece repair shop is still the number one choice of dentists for air-powered handpiece repair. For electric handpiece repair, the number one choice was returning them to the handpiece manufacturer.[19]

Table 3: What to consider when choosing a handpiece repair service

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. Without adequate training, even a well-meaning person will produce poor results.

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. 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 a reputation for excessive breakdown and expense. When maintained properly, handpieces will provide many years of optimal performance. When repairs are necessary, consideration should be given to the quality of the repair and reliability of a qualified service provider to restore your workhorse to optimal performance.

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GLENN WILLIAMS, BS, is a 35-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 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.

AUTHOR DISCLOSURE

Glenn Williams, BS, owns and operates an independent repair service in Round Rock, Texas, and is the president of the National Dental Handpiece Repair Association.

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QUESTIONS

1. In what decade was the first air-driven handpiece introduced in the US?

A. 1940s
B. 1950s
C. 1960s
D. 1970s

2. Some advantages of an air turbine handpiece over the older belt driven technology were:

A. A smoother cut
B. Higher speeds
C. Less vibration
D. All of the above

3. Rapid advances in handpiece features that occurred during the 1980s included:

A. Fiber optic lighting
B. Automatic chucking
C. Quick disconnects
D. All of the above

4. One advantage of a swivel/quick disconnect handpiece is:

A. Usually weighs less
B. Speeds up time required to lubricate the handpiece
C. Automates bur rotational speed adjustment
D. Compatible with any handpiece

5. How is light delivered through a high-speed handpiece?

A. Small batteries
B. Tiny light bulbs
C. Optic fibers
D. Wires

6. In 1992, dental handpiece maintenance changed dramatically due to:

A. Modern handpieces requiring more maintenance
B. Lights in the handpieces
C. A woman infected with the AIDS virus and the dental office was the source of infection
D. Handpiece maintenance did not change, traditional methods for disinfection is sufficient

7. When did the FDA issue the first guidelines mandating routine handpiece sterilization?

A. 1979
B. 1984
C. 1990
D. 1993

8. FDA regulations expressly prohibit:

A. Returning opened handpiece boxes to the manufacturer
B. Lubricating a handpiece before autoclaving
C. Sterilizing more than one handpiece at a time
D. Brushing a handpiece under running water

9. What is one trade-off clinicians face regarding the head of a handpiece?

A. Lighter vs. heavier
B. Size vs. power
C. Straight vs. angled
D. All of the above

10. Why does the angulation of the handpiece head matter clinically?

A. Better grip on the handpiece
B. Can restrict access to the oral cavity
C. Can affect visibility
D. Both B and C

11. What factors should a clinician consider before purchasing handpieces?

A. Head size
B. Sound level
C. Power
D. All of the above

12. Increased decibels from a high-speed handpiece can cause:

A. Problems with bur retention
B. Patient anxiety
C. Faster procedures
D. Longer preparation times

13. High-speed handpieces deliver water through the head to:

A. Cool down the outer surface of the handpiece
B. Keep the bur from going too fast
C. Cool down the tooth structure
D. None of the above

14. Fiber optics can refer to:

A. Glass fibers inside the handpiece
B. Solid glass rods inside the handpiece
C. LED light bulbs
D. All of the above

15. The single biggest difference between electric and air-driven handpieces is:

A. Constant speed
B. Weight
C. Sound levels
D. Fiber optics

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QUESTIONS

16. At what speed do electric handpiece motors operate?
A. 400,000 rpm
B. 200,000 rpm
C. 40,000 rpm
D. 10,000 rpm

17. What are some disadvantages of electric handpiece attachments?
A. Larger head size
B. Heavier than air-driven handpieces
C. More expensive than air-driven handpieces
D. All of the above

18. What is one effect of repeated sterilization on high-speed handpieces?
A. Quieter operation
B. Life expectancy drops
C. Handpieces last longer
D. All of the above

19. About how long will a handpiece last before needing service if autoclaved twice a day five days a week?
A. Six months
B. One year
C. Eighteen months
D. None of the above

20. What is the number one safety concern when using electric handpieces?
A. Rotating the bur too fast
B. Removing too much tooth structure
C. Overheating causing patient tissue burns
D. Automatic motor shut off

21. What is the most common material high-speed handpieces are made of?
A. Aluminum
B. Stainless steel
C. Brass
D. None of the above

22. What is "drive air" used for in a high-speed handpiece?
A. Rotating the turbine
B. Cooling off the tooth structure
C. Exhausting used air
D. Both B and C

23. One sign of turbine bearing wear is:
A. Greater concentricity
B. Lower speed
C. Longer run down time
D. All of the above

24. The concentricity of the handpiece turbine affects the following:
A. Smoother tooth preparations
B. Less vibration
C. More patient comfort
D. All of the above

25. Which of the following is the only moving part inside a high-speed handpiece?
A. Chuck
B. Swivel
C. Turbine
D. Optic rod

26. Where is the best place to measure handpiece air pressure?
A. Dental unit air gauge
B. At the handpiece connection
C. At the head of the handpiece
D. Utility box regulator

27. Which of the following is not a recommended maintenance procedure?
A. Run the handpiece to evenly distribute oil through the bearings and chuck mechanism
B. Spray lubricant into the handpiece
C. Flush the waterline
D. Wipe the handpiece with a chemical disinfectant wipe

28. Which of the following factors can negatively impact handpiece life?
A. Lubrication
B. Air pressure
C. Type of dental practice
D. All of the above

29. Which of the following are common handpiece maintenance mistakes?
A. Not using enough lubricant
B. Lubricating in the wrong hole
C. Not running the handpiece after oiling
D. All of the above

30. Which of the following is true?
A. A rebuilt turbine is as good as a new turbine
B. A rebuilt turbine includes a new autochuck
C. A rebuilt turbine saves money
D. All of the above

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Anatomy of a handpiece: Understanding handpiece maintenance and repairs

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EDUCATIONAL OBJECTIVES

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.

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1. Were the individual course objectives met?

Objective #1: Yes No   Objective #2: Yes No

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Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

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8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
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