Synopsis of Electric Handpieces for General Dentistry (Project 03-40) (5/04)

Introduction

Electric handpieces have been used in the United States for many years for oral surgery, endodontics and in the dental laboratory. They have only recently been developed and marketed for use in general dentistry.

There are numerous advantages and disadvantages with electric systems when compared to traditional air turbine high-speed and air motor low-speed handpieces. Manufacturers of electric handpieces tout their high power, constant torque, concentric bur movement, low vibration level and low noise level. Some often quoted disadvantages are higher cost, heavier handpiece, learning curve, and infection control concerns.

System Basics

Electric handpiece systems consist of a control unit, cord, micromotor and various attachment/handpiece options. Most systems are easily connected to existing dental units. They require 120 VAC, connect to the dental unit compressed air (40-60 psi), and use the existing dental unit rheostat. Depressing the rheostat, activates a solenoid in the micromotor which produces the electrical energy required to rotate the bur.
The speed can be controlled by the operator in a number of ways: rheostat, interchangeable attachments/heads with different gear ratios, programmable functions, up/down buttons and arrows, and potentiometers (control knobs).

Virtually all externally mounted units can be connected in a matter of minutes and can be easily disconnected and reconnected in another operatory. Most manufacturers also offer internally ("permanently") mounted options, allowing the control pad and handpiece to blend in with the dental unit.

Component Parts

An externally mounted *control unit* can easily fit on the bracket tray. Most units have a forward/reverse option, an LED display to show either micromotor or bur speed, up/down speed-range arrows, and various programming options. Some of the newer systems offer auto-reverse/torque-control and are promoted as general dentistry and endodontic units.

The electric *micromotor*, with attachment, is typically heavier than an air turbine handpiece. Many of the recently introduced motors are brushless (no periodic brush changes required) and are being promoted as "maintenance free". However, replacement brushes are relatively inexpensive and the required periodic brush changes can be easily accomplished by the operator, making the primary advantage of brushless motors somewhat debatable.

All micromotors have a standard E-type connection allowing them to accept other manufacturer's handpiece attachments, which simply snap on and off. However, due to some incompatibilities in fiberoptic systems there is not total interconnectivity. Electric micromotors operate at speeds ranging from 1,000 to 40,000 rpm. They are usually air-cooled, yet water is still necessary to cool the bur and the operative site. All electric handpiece attachments require cleaning/lubrication before sterilization and most can be maintained on automatic handpiece maintenance systems.

The *attachment/handpiece* options typically include a 1:5 increasing "high-speed" attachment (i.e., 5K to 200K rpm), a 1:1 "low-speed" attachment (i.e., 1K to 40K rpm) and a variety of speed decreasing attachments such as the 1:27 "endodontic" attachment which can result in an endodontic rotary file speed range of 50 to 1500 rpm. Some manufacturers offer as many as 27 attachments while others offer as few as three. Most manufacturers offer a low speed latch as well as friction grip.

The *cord* is usually six feet long, lightweight and engineered to minimize resistance or drag on the handpiece. Many units have a “swivel” feature between the cord and micromotor to combat drag or resistance from the cord. Some units have a swivel feature built into the micromotor.

Operating Speed

Air turbine high-speed handpieces have maximum speeds up to 400,000 rpm. Traditional low-speed air motor handpieces have maximum speeds up to 40,000 rpm. Since electric handpiece micromotors have a maximum speed of 40,000 rpm, manufacturers hesitate to use the term “high-speed” when referring to electric systems, even though the systems are marketed for gross reduction. However, when referring to the 1:5 increasing attachment (with resulting speed range of 5,000 to 200,000 rpm) most users are referring to the 1:5 attachment as a “high speed” and the 1:1 attachment as a “low speed”.
When a bur in an air turbine handpiece engages dentin, the rpm reduces significantly – often to the 200,000 rpm range. When a bur in an electric handpiece engages dentin, it continues to run at its maximum speed of 200,000 rpm, with very little reduction in torque.

Materials

Handpieces have traditionally been made of stainless steel, however many manufacturers are now using titanium. Titanium is lighter and stronger than stainless steel, but more difficult and expensive to manufacture. The “titanium” attachments that some manufacturers market may not weigh significantly less than stainless steel handpieces since only a portion of the attachment is made of titanium. Micromotors may have a titanium housing or sleeve, however most internal parts will still be made of steel, copper and nickel. Since electric micromotor/attachment combinations are larger and heavier than air turbine handpieces, the feel and “balance” becomes more important. A heavier, but well-balanced micromotor/handpiece combination may have a better feel than a lighter imbalanced combination.

Advantages / Disadvantages

Some of the manufacturer commonly-cited advantages are:

1. More power and torque than air turbine handpieces.
2. Better bur concentricity.
3. Less vibration and noise.
4. Broad, controllable speed ranges.
5. Forward/reverse option.
6. With appropriate attachments, one system can be used for restorative, prosthodontics, prophies and endodontics.

Some of the apparent disadvantages are as follows:

1. Heavier than air turbine.
2. More expensive.
3. Learning curve may be required.
4. Attachment heads not as small as the small-head air turbines.
5. May not be able to fully replace the air turbine.
6. Infection control concerns.

Infection Control

Presently, most electric handpieces do not meet two major infection control requirements. While most electric micromotors cannot withstand heat sterilization, many of the housing/sleeves around the micromotor can be autoclaved. However, unless the micromotor itself can be heat sterilized, DIS does not recommend purchasing these systems for USAF dental clinics. Furthermore, most manufacturers have not completely addressed the area of dental unit waterline (DUWL) asepsis. Commercial devices and

procedures designed to improve the quality of water used in dental treatment are available; methods demonstrated to be effective include self-contained water systems combined with chemical treatment, in-line microfilters, and combinations of these treatments. Simply using source water containing <500 CFU/mL of bacteria (e.g., tap, distilled, or sterile water) in a self-contained water system will not eliminate bacterial contamination in treatment water if biofilms in the water system are not controlled. Removal or inactivation of dental waterline biofilms requires use of chemical germicides. Presently, manufacturers have not fully addressed this issue and cannot offer complete information on acceptable products to use or protocols to follow for cleaning the DUWL attached to the electric handpiece. Therefore, when considering the purchase of an electric handpiece system, ensure that the current procedure being used to treat the DUWL in your clinic is compatible with the electric handpiece system.

Summary

Electric handpiece systems for general dentistry are being aggressively promoted by dental manufacturers. With many recently introduced systems on the market this synopsis should assist the reader in comparing and contrasting them. However, while there appear to be potential advantages to using electric handpieces in general dentistry, DIS recommends that USAF personnel proceed cautiously before purchasing a system, since most systems do not meet the two critical infection control requirements of having a heat-sterilizable micromotor and clearly acceptable DUWL protocols.

Synopsis of Electric Handpieces* (5/04)

Product	A-dec Electric	Apex	ELECTRO torque Plus	Midwest eStylus
Manufacturer	A-dec/W&H 2601 Crestview Dr. Newberg, OR 97132 (800) 547-1883 (503) 538-7478 (503) 538-0276 FAX www.a-dec.com	Lares Research 295 Lockheed Ave. Chico, CA 95973 (800) 347-3289 (530) 345-1767 (530) 345-1870 FAX www.laresdental.com	KaVo 340 E. Main St. Lake Zurich, IL 60047 (888) 528-6872 (847) 550-6800 (847) 550-6825 FAX www.kavo.com	Dentsply Professional 901 West Oakton St Des Plaine, IL 60018 (800) 800-2888 (847) 640-4800 (847) 640-6165 FAX www.dentsply.com
Micromotor model	EA 40 LT	Apex Electric	Intramatic LUX 701 KL	Standard eStylus
Micromotor speed (rpm)	2,000 - 40,000	4,500 - 40,000	2,000 - 40,000	1,500 - 40,000
Motor type	Brushless	Brushes	Brushless	Brushes
Number of available attachments	8	3	6 (7 interchangeable heads, numerous options)	4
Attachment gear ratios (bur rpms)	1:5 (10K - 200K) 1:1 (2K - 40K) 2:1 (1K - 20K) 4:1 (500 - 10K) 10:1 (200 - 4K) 70:1 (30 - 550) 128:1 (16 - 300)	1:5 (22.5K - 200K) 1:1 (4.5K - 40K) 5.2:1 (860 - 7.7K)	1:5 (10K - 200K) 1:1 (2K - 40K) 2.7:1 (740 - 15K) 7.4:1 (270 - 5.4K) (head-extenders of 1:1, 2:1, 10:1)	1:5 (7.5K - 200K) 1:1 (1.5K - 40K) 10:1 (150 - 4K)
Manufacturer recommended uses	Restorative Endodontics Prosthodontics	Restorative Prophy	Restorative Endodontics Prosthodontics Prophy	Restorative Endodontics Prosthodontic Prophy
Programming options	Programmable, 3 presets	None	Two pre-set buttons	12 custom settings plus endo mode w/4 pre-set torque limits, auto-reverse
Number of ports available for water/airdelivery	High speed - 3 port Low speed - 1 port	High speed - 3 port Low speed - 3 port	High speed - 3 port Low speed - 1 port	High speed - 4 port Low speed - 4 port
360° swivel available	No	Yes (swivels between motor and cord)	Yes (swivels between motor and cord)	Yes(swivels between motor and cord)
Air requirements	50 - 55 psi	55 - 60 psi	44 psi	40 - 60 psi
Fiberoptics	Single glass rod	Twin beam fiber bundles	25,000 lux, cellular glass rod optics (3rd gen)	Fused rod
Micromotor weight	79 gms	104 gms	99 gms	98 gms
Micromotor metallurgy	Stainless steel housing. Interior: stainless steel with peak copper windings	Stainless Steel	Stainless steel, nickel-silver alloy, galvanized surface	Stainless steel housing. Interior: standard copper windings
Attachment metallurgy	Stainless steel, nickel-chrome plated	Stainless Steel	Stainless steel, nickel-silver alloy, galvanized surface	Stainless steel

Autoclavable micromotor housing	Yes	Yes	Yes	Yes
Autoclavable micromotor	Yes	No	No	No
Unit dimensions (externally installed, H x W x D, inches)	2.25 x 4 x 5.25	3 x 4.9 x 4.9	2 x 5 x 6	2 x 4.5 x 7
Electrical requirements	120 VAC, 50-60 Hz	120 VAC, 50-60Hz	110 VAC, 50-60Hz	115/230 VAC, 50/60Hz
Warranty	1 yr - motor/unit/cord 1 yr - attachments	1 yr - motor/unit/cord 1 yr - attachments	3 yr - motor/unit/cord 1 yr - attachments	2 yr - motor/unit/cord 1 yr - attachments
Price (retail/govt) (electric system)	$2700.00 / $1377.00	$1349.00 / (call for govt)	$2905.00 / 1888.00	$2458.00 / $1352.00
Price (retail/govt) (1:5 attachment)	$1320.00 / $685.00	$899.00 (call for govt)	$1540.00 / $1001.00	$1295.00 / $712.00

Synopsis of Electric Handpieces* (5/04)

Product	**Optima T+R**	**Siro Torque L**	**Ti-Max EL 400**	**Titan E-lectric**
Manufacturer	Bien-Air 17880 Skypark Circle Irvine CA 92614 (800) 433-2436 (949) 477-6050 (949) 477-6051 FAX www.bienair.com	Sirona 4835 Sirona Dr. St 100 Charlotte, NC 28273 (800) 659-5977 (704) 587-0453 (888) 297-8631 FAX www.sirona.com	NSK America 700B Cooper St. Schaumburg, IL 60173 (888) 675-1675 (847) 843-1412 (847) 843-7622 FAX www.nsk.com	DentalEZ / Star 1816 Colonial Village Ln Lancaster, PA 17601 (866) 383-4636 (717) 291-1161 (717) 291-5699 FAX www.dentalez.com
Micromotor model	MC3LK	EL 1	TiM40	Titan E-lectric
Micromotor speed (rpm)	60 - 40,000	1,000 - 40,000	1,000 - 40,000	1,000 - 40,000
Motor type	Brushes	Brushless	Brushes	Brushes
Number of available attachments	30	25	6	5
Attachment gear ratios (bur rpms)	1:5 (300 - 200K) 1:1 (60 - 200K) 2:1 (30 - 20K) 7:1 (8 - 5.7K) 10:1 (6 - 4K) 30:1 (0 - 1,334) 100:1 (0 - 400)	1:5 (10K - 200K) 1:1 (1K - 40K) 6:1 (160 - 6K) 24:1 (40 - 1.6K)	1:5 (10K - 200K) 1:1 (1K - 40K) 16:1 (100 - 2.5K)	1:5 (10K - 200K) 1:1 (1K - 40K) 16:1 (100 - 2.5K)
Manufacturer recommended uses	Restorative Endodontics Prosthodontics Prophy Surgery Implants	Restorative Endodontics Prosthodontics Prophy Surgery Implants	Restorative Endo Prosthodontics	Restorative Endodontics Prosthodontics

Programming options	2 programs	Two speed selections	None	None
Number of ports available for water/airdelivery	High speed - 3 port Low speed - 3 port	Choice of 1, 2, or 3 ports for all attachments	High speed - 4 port Low speed - 3 port	High speed - 4 port
360° swivel available	Yes (swivels at handpiece/ motor and motor/cord)	Yes (swivels between motor and cord)	No (but cord is flexible)	No
Air requirements	45 psi	40 psi	35 psi	32 psi
Fiberoptics	Dual glass rod	Power optics	Glass rod	Solid glass rods
Micromotor weight	91 gms	100 gms	106 gms	102 gms
Micromotor metallurgy	Steel alloy, hard chrome surface	Stainless steel housing, ironless interior	Titanium housing	Titanium housing
Attachment metallurgy	Steel alloy, hard chrome surface	T1 line - titanium outer T2 Revo line - chrome-plated	Titanium	Titanium
Autoclavable micromotor housing	Yes	Yes	No update, click here.	Yes
Autoclavable micromotor	No	No	No update, click here.	No
Unit dimensions (externally installed, H x W x D, inches)	3 x 3.25 x 6.75	2.75 x 6 x 5.25	2 x 4.5 x 5.5	5.25 x 4.25 x 1.5
Electrical requirements	110V, 50-60 Hz	120 VAC, 50-60 Hz	120/230 VAC, 50-60Hz	120/230 VAC, 50-60Hz
Warranty	2 yr - motor/unit/cord 1 yr - attachments	2 yr - motor/unit/cord 2 yr - attachments	3 yr - motor/unit/cord 1 yr - attachments(30 day risk free trial)	3 yr - motor/unit/cord 1 yr - attachments
Price (retail/govt) (electric system)	$2100.00 / $1050.00	$1895.00 / $1232.00	$1350.00 / $877.00	$1650.00 / $1017.00
Price (retail/govt) (1:5 attachment)	$1154.00 / $577.00	$1395.00 / $907.00	$880.00 / $616.00	$995.00 / $591.00

*The manufacturers provided information in these tables.

Update

NSK Corporation has introduced the **Ti-Max NL400** Brushless Electric Micro Motor System. This system has many features of the NSK Ti-Max EL 400 system with some improvements. The micromotor is now autoclavable and is purportedly one of the lightest weight (76 gm) micromotors on the market. The control unit offers two programmable settings and Brasseler USA states that any dental unit waterline treatment is acceptable for this unit. It can be purchased for $1,695.00 (retail) and $1,101.75 (government). For more information contact Brasseler USA at (800) 841-4522, (912) 925-8525, (888) 610-1937 FAX or www.nskamerica.com.