



Dental handpieces – what should you look for before purchasing?

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What high-speed instruments are currently available on the market? What are the current trends in restoration and prosthetics and what future developments can be expected? The following sections provide information that will assist you in the fast and correct selection of the right dental handpieces for you.

Dental handpieces such as contra-angle handpieces and turbines are now viewed as more than simply “commodity products”. However, the information below makes it clear that this view is not adequate. Dental handpieces are among the most important tools for dentists and form an important part of every modern dental practice.

Air systems vs electrical systems

There are two systems for powering burs: air and electrical. In the air system a distinction is made between a turbine and an air motor.

With turbines the bur is directly driven by a rotor. The rotor has an impeller powered by compressed air. Turbines reach an idle speed of up to 400,000 min^{-1} . The working speed depends on the pressure exerted and is approximately half the idle speed - i.e. approx. 150,000 to 250,000 min^{-1} . The maximum power of 10-26 W is also reached in this speed range.

The air motor drives the bur indirectly via a contra-angle handpiece or straight handpiece. It reaches a maximum speed of 25,000 min^{-1} . Contra-angle handpieces are available in various step-up and step-down ratios. An air motor with a 2:1 contra-angle handpiece step-down ratio thus reaches a speed of approx. 12,500 min^{-1} .

Electric motors reach an idle speed of up to 40,000 min^{-1} . This corresponds to a bur speed of 200,000 min^{-1} for 1:5 contra-angle handpieces. The maximum power is over 60 W and the torque is approx. 3 Ncm. This means that electrically powered contra-angle handpieces are not slowed or stopped when the bur cuts through different tooth structures or prosthetic materials. They continue cutting at virtually constant speed regardless of the load. Compared to turbines, burs are much more stable with contra-angle handpieces. Burs in a contra-angle handpiece vibrate much less than with turbines. Improved stabilization means greater precision, faster work and less heating of the tooth substance during preparation.

The trend towards electric motors was first noticed in Europe. One important reason for this was the potential expense of installing new air lines in existing buildings. It also became obvious that electric drives are not only easier to install but are also more efficient in use.



Now, some decades later, electric motors have become very popular in both Europe and Asia. Innovative developments in the fields of design, materials, torque and light are now also contributing to the popularity of electric motors in North America. They make work in the dental practice faster and easier.

The currently available range of straight and contra-angle handpieces includes the right instrument for every requirement. Most manufacturers offer products suitable for a wide range of applications and also products for highly specialized clinical applications.

Turbine vs contra-angle handpiece

The advantages of the turbine are its simple and robust structure, the lower purchase price and also the lighter weight. However, over the years the detrimental effect on the operator's hearing due to the high-frequency sounds emitted by the turbine has become a significant problem. Electric motors, in contrast, are quieter and cause less hearing damage than turbines. When the quantity of tooth substance removed per unit of time is considered, it is clear that electric motors with water cooling are superior to turbines for grinding.

With the continuing development of motors in recent years, manufacturers have clearly acknowledged that the ergonomics of the weight and size of dental handpieces plays a decisive role in purchasing decisions. The reduction in weight and size is very obvious compared to instruments manufactured in the last three to five years. It is not uncommon to see weights reduced by up to 30% and sizes by as much as 15%. This advance is due to the reduction of the ISO fitting on the motors. Note that “shortened contra-angle handpieces” can only be used on motors with a reduced E-fitting. Even with the general trend to weight reduction, turbines are still smaller and lighter than contra-angle handpiece systems powered by electric motors.

Optimal light, but where and which?

Instruments with light have become popular over the last 20 years. The source of the light has generally been halogen lamps with light transmitted through glass rods illuminating the treatment site. Improved illumination of the treatment site by light instruments is desirable, even necessary, in all fields. Instruments with light are now basic equipment in every dental practice.

A second major milestone in lighting quality was achieved in 2007 with the introduction of LEDs to replace halogen lamps. The longer service life of LEDs in micromotors and turbines or couplings has resulted in a significant improvement in the quality of illumination and treatment. Colour accuracy and colour temperature have also been gradually optimized.

The latest innovation is the integration of multiple LEDs in the instrument head – a world first in the development of dental illumination! Shadow-free illumination of the treatment site with high colour accuracy and adequate illuminating power provides a completely new view of the oral cavity.



Selection criteria:

- **Head technology**



Image 1: Microturbine head

Image 2: Hygienic head system

The smaller the head the better the access to and view of the treatment site. The purchaser should consider not only the diameter and the height of the head but also the working height (head + bur). The smallest turbines have a working height of about 17 mm (with a bur length of 16 mm). The heads of these miniature turbines have a diameter of less than 9 mm and a height of approx. 10 mm. Despite their very small size, they still offer high power. The products had to be designed with special applications in mind to allow such small head dimensions. This means that microturbines can be used for minimally invasive applications and for patients with a small mouth opening (children and older patients). Some manufacturers have even integrated two impellers into the turbine to meet these requirements.

The turbine rotor tends to suck air from its immediate vicinity when slowing down. Consequently, there is a danger of sucking contaminated air into the interior of the turbine. Modern turbines now have what is referred to as a hygienic head. This innovative system prevents external air from being sucked into bypass channels.

- **Speed range**

The idle speed (approx. $400,000 \text{ min}^{-1}$) of turbines is an indicator of their cutting performance. The advantage of electric motors is that the speed and torque can be very easily controlled. The speed of brushless electric motors can be controlled within a range of approx. 100 to $40,000 \text{ min}^{-1}$. These motors offer a stable torque throughout their entire speed range. More and more dentists are using electric motors. When service life, hygiene, wear and sterilizability are considered, brushless electric motors are to be preferred to motors with brushes.



- **1.6 mm FG chuck system for high-speed instruments**

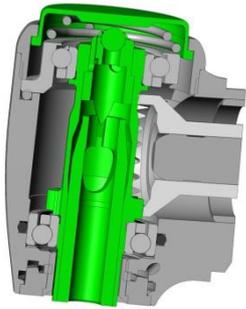


Image 3: FG (friction grip) chuck system, 1.6 mm

The current standard is press button chuck systems. This system does not require a tool for changing burs. It should be possible to change burs with the least possible actuation force. However, on the other hand, the actuation force should not be so low as to allow accidental actuation, for example by contact with the patient's cheek. The retaining force must be sufficient to clamp the bur tightly. Swallowing or inhaling a bur is life-threatening for the patient. As the high speeds of the instruments generate very high centrifugal forces, manufacturers must provide the best possible solutions for changing burs easily and also for clamping them securely. A quickly and easily operated chuck system with sufficient retaining force is ideal for holding burs securely in place.

- **Spray system, cooling**



Image 4: Turbine with 5x Spray



There are two important reasons for spraying the treatment area with air and water:

Cooling the tooth to prevent overheating of the pulp. The abraded material is removed to prevent obstruction of the view of the treatment site. Studies by Sharon C. Siegel, M.S., D.D.S., and J. Anthony von Fraunhofer, M.S.C., Ph.D., F.A.D.M., F.R.S.C., also confirm a relationship between the number of spray channels and the cutting performance. Instruments with multiple spray channels demonstrate significantly greater cutting performance compared to instruments with only one spray channel.

Studies by H. H. Martin and H. A. Gleinser, Freiburg, provide information on the relationship of the volume of spray water, the number of nozzles and the temperature increase of the tooth substance during preparation. Turbines and high-speed contra-angle handpieces with single, double and multi-spray systems were tested. In summary, these studies concluded that: A 3x-nozzle spray system delivering 50 ml of water per minute resulted in the lowest temperature increases. The temperature increased markedly at a lower water delivery rate of, for example, 15 ml/min, even with multi-spray systems.

An innovation in 2007 was instruments with five spray channels. Instruments with multiple spray channels offer greater efficiency, improved vision, less danger of failure if a channel becomes blocked and greater safety for the patient. Multiple channels ensure sufficient cooling with the remaining channels, even if a neighbouring tooth is blocking some spray.

- **Illumination**



Image 5: First turbine with 5x ring LED+

Most dentists would always like a better view of the treatment site. A head-mounted dental light is inadequate for illumination in the restricted space of the mouth with various dental instruments and hands blocking the light. The best solution is to use instruments with an integrated light source that can directly illuminate the treatment site. Instruments with a halogen light transmitted directly to the head of the instrument via glass rods only a few millimetres from the bur have become standard equipment in recent decades. The field of illumination is restricted to the immediate vicinity of the bur.



The first instruments with LED lights (LED = Light Emitting Diode) were manufactured in 2007. With a colour temperature of 5,500 K and a light intensity of 25,000 lux, LEDs provide daylight-quality light directly at the treatment site. The position of the LED on the instrument head provides a wide area of diffuse illumination over the complete treatment area.

In 2009 another innovation was contra-angle handpieces with an LED light that does not require a power supply from the dental unit. The power for the LED is supplied by a generator driven by forced air integrated into the instrument. This generator technology has been successfully used with oral-surgery instruments since 2007.

The first multi-LED light turbine with a unique 5x ring LED+ in the world was presented at the International Dental Show in Cologne in 2013. Five LEDs in the head of the turbine provide 100% shadow-free illumination of the treatment site. This innovation establishes a completely new standard in lighting technology. For the first time the dentist is able to illuminate the preparation site from all angles. The improved view enables more precise work for restoration and prosthetics. The result is less stress and improved quality for both patient and dentist. Light instruments should be sterilizable and thermo washer disinfectable to allow complete integration in the practice and the hygiene process.

- **Coupling**



Image 6: Sterilizable quick coupling with power connection for LED

Hygiene requirements specify that turbines, contra-angle handpieces and motors must be sterilized after every patient. It is important to be able to connect and disconnect the instruments to and from the hose quickly and easily. Time-consuming assembly requirements should be avoided. Couplings must also be sterilizable.



- **Hygiene and Maintenance**



Image 7: Cleaning and maintenance unit with instruments

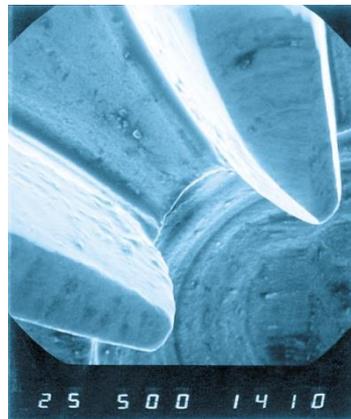
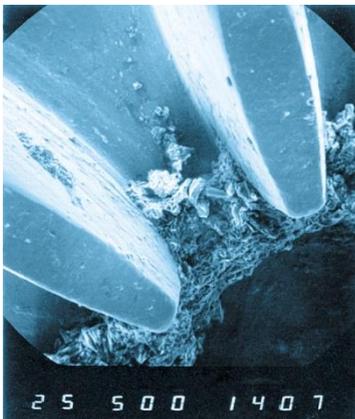


Image 8/9: Gearing components before (left) and after (right) the cleaning process

An effective cleaning and maintenance system is essential for a functional maintenance process. Different instrument designs from different manufacturers demand specific cleaning and maintenance processes. It is important to select instruments that do not require complicated cleaning and maintenance and can be easily maintained in the practice. Manufacturers also offer cleaning and maintenance units designed for that manufacturer's instruments. These units are to be recommended, because regular cleaning and maintenance greatly extends the service life of instruments. Internal and external cleaning of instruments is particularly important. A wide range of products for these processes is available on the market. A product



that can be fully integrated into the instrument preparation process should be selected. For example, the Assistina 3x3, a combination unit for internal and external cleaning and oil service, can be used in combination with a sterilizer for a complete cleaning and maintenance process.

- **Sterilization**



Image 10: Sterilizer

Every instrument is sterilized several times a day. Only high-quality instruments can be subjected to so many cycles without losing functionality or performance. The sterilization process must conform to the manufacturer's specifications to ensure the longest possible service life for the instruments. The sterilization process must not exceed the maximum permissible temperatures. Vacuum-steam sterilization is generally considered to treat the material with care and to be reliable.

Recommended



Image 11/12/13: Thermo washer disinfector

Sterilizable 135 °C

Data matrix code



It is important to be able to integrate straight and contra-angle handpieces, turbines and motors into the hygiene and maintenance process without any problems. The most important factors in reprocessing are the option of thermo washer disinfection and the sterilizability of instruments and drives. A data matrix code makes it easy to identify the instruments during documentation of the hygiene process.

Checklist – what you should look for when purchasing dental handpieces:

- *Branded products*

Only buy products made by established manufacturers. You will often see special offers from cheap manufacturers. The products from such suppliers are generally of poor quality and usually do not comply with regulations and standards.

- *After-sales service*

Comprehensive service of medical devices retains their value and extends their service life. Qualified service centres can also offer prompt assistance in case of problems with the product.

- *Warranty*

Compare warranty periods and find out which components are not covered by the warranty. Wear parts such as ball bearings are often not covered by the warranty.

- *Always compare head sizes with burs*

Small heads often lead to a quick decision for a product, but when a bur is clamped in place they can look quite different.

- *LED light*

Light is not simply light: find out what light values are achieved and, if possible, compare the size of the illumination field. The size of the illuminated area is particularly restricted with glass rods. LEDs integrated into the instrument head are the ideal solution.

- *Size and weight*

Ergonomics is an important factor. The use of titanium has not yet solved this problem. You will be surprised at the low instrument weights that can be achieved with other materials.



- *Power and speed*

Don't be distracted by high idle speeds and high power specifications. A test of the power under load will quickly show whether the product has sufficient power or not.

- *Care – the alpha and omega*

A reliable unit from the same manufacturer is a guarantee that the instruments will be correctly maintained. Machines need lubrication to function correctly – or would you accept compromises with your car?

- *Sterilization*

Careful selection of a sterilizer can save money. Sterilizers with vacuum eliminate residual moisture in the instruments and extend the service life.

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Company profile:

W&H Dentalwerk - People have Priority

The family company W&H Dentalwerk, based in Bürmoos near Salzburg, Austria, the only Austrian manufacturer of dental precision instruments and devices, is one of the leading providers of dental devices in the world. Innovative product and service solutions, a modern corporate structure, a strong focus on research and development, as well as social responsibility – this is what makes W&H Dentalwerk a successful local and global player. With around 1,000 employees worldwide (600 of whom work in the Austrian headquarters in Bürmoos), W&H exports its products to more than 110 countries. The family company operates two production sites in Bürmoos (Austria), one in Brusaporto (Italy) and 19 subsidiaries in Europe, Asia and North America.

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