ARTICLE: Disposable Surgical Instruments are Single-Use Only

The widespread use of dental diamonds for cutting dental tissues and prosthetics is a global phenomenon. Teeth, gingiva, bone, and restorations are routinely cut with diamonds. Inadvertent collateral damage of tongues, cheeks, lips, palates, other tissues and adjacent restorations can occur with diamonds.

What exactly are diamond instruments? What are their limitations? What are their applications? Can they be predictably re-used? What is the cost of re-use of a diamond? Is there a predictable and reliable method of debridement, cleansing and sterilization of diamonds? These are common questions that the authors have fielded in educating students, residents, clinicians and patients. All of these questions are interrelated.

Dental diamonds are rotary cutting instruments that are used with dental handpieces (slow and high speed). Diamonds are embedded in a soft nickel (along with other alloys) matrix on a metal bur shank. (See graphic 1)

The diamond is the hardest cutting substance that is available. The diamonds "abrade" their hard targets and soft targets. The "rough" diamonds appear quite differently under the microscope than most clinicians imagine. (See photomicrograph A) The diamonds provide many different and random cutting surfaces rather than a straight or well organized cutting edge of a scalpel or carbide bur. These diamond edges provide the irregular cutting action when applied to a surface in a rotary motion.

The soft matrix is the weak "link" in the cutting "chain". The diamonds can be "plucked-out in this process. Diamonds can be fractured along existing fracture planes or lines. This fracturing will yield yet another sharp diamond edge. The more resistant target materials such as stainless steel, titanium alloys, and partial denture frameworks that are harder or tougher than the soft nickel matrix can remove diamonds from its matrix. There is a threshold for the amount and spacing of the diamond particles as placed within the matrix system. To Few diamond particles yield fewer cutting surfaces and less total cutting surface. This decrease in total cutting surface reduces the cutting ability of the diamond. To many diamond particles also decreases the cutting surface area, again decreasing the cutting ability of the diamond.

The authors have not observed any cutting instrument that gets sharper or more effective with use. The issues of

- Decreased cutting efficiency
- Possible tearing rather than cutting soft tissues
- Increased heat generation with cutting
- Potential heat damage to tissues (i.e. pulpal heating)
- Decreased cutting rates (Increased time to cut)
- Denuded bur matrix (loss of diamonds) contacting tissues creating discoloration and heating of tissues and prosthetics
- Increased chair time

All of the factors increase with the use of individual diamond instruments.

Use of diamonds create a "smear layer" or "debris layer" on the instrument (see photomicrograph B). This "debris layer" coats and can completely obscure the diamonds and matrix. This clogging effect may decrease cutting efficiency significantly. Cutting composite and tooth structure appear to create a greater "debris layer" than cutting metals. The cutting of metals (titanium, nickel chrome and stainless steel) creates

a significant loss of diamonds from the matrix versus healthy and carious tooth structures. (See photomicrograph C).

There are standardized sterilization protocols for dry heat and pressurized steam. These methods are the most common in dental offices. Prior to sterilization the instruments must be completely debrided and cleansed. No foreign bodies or materials can be on the surface of the instrument. Debris contaminated surfaces can neither be effectively dry heat or pressurized steam sterilized. There is also the issue of foreign bodies or materials being introduced into a surgical site as well as cross contamination with a reused diamond instrument.

The professional community standard of care and licensing board regulations require sterile instruments. The liability issues with the government and patient litigation need to be avoided. Professionals should not need a "club" to be held above their heads to provided safe and effective treatment for patients.

Is there a consistent and reproducible protocol for debridement and cleansing diamond instruments prior to effective sterilization? Is this protocol cost effective?

All ultrasonic cleaners tested were more compatible than deionized water. Non-ionic and low-concentration enzymatic solutions were less reactive. (7)

The authors utilized the following pre-sterilization debridement and cleansing protocol:

- Coltène Whaledent BioSonic® UC300 ultrasonic cleaning with a in separate glass beaker for 5-20 minutes with fresh Pro Portion® (Sultan) ultrasonic cleaning solution
- Profuse rinsing with water
- Ultrasonic cleaning in separate glass beaker for 5-10 minutes with distilled water
- Profuse rinsing with water

New Piranha 856-016 Coarse diamonds (SS White Burs Inc.) were used to prepare a single molar for a traditional porcelain or high noble gold crown. Each individual used Piranha diamond was individually put through the above pre-sterilization debridement and cleansing protocol.

Coltène Whaledent BioSonic® UC300
Ultrasonic cleaning is accomplished with the generation of millions of minute bubbles that implode (explode inwards) that are produced from high frequency sound waves. The cavitation that is created by the sound waves and implosions is high energy. The implosion creates energy waves. Tremendous amounts of energy are applied to all of the surfaces of the instruments. The instrument is scrubbed clean on micro and macroscopic levels where manual brushing is of limited use.

Ultrasonic cleaning solutions such as Pro Portion® (Sultan) provide surfactants and detergents to improve the cleaning process. The combination of cleaning chemicals and ultrasonic energy can provide effective cleaning or debris off of the surfaces of instruments.

The Electron Micrographs (see D&E) demonstrate that if the Diamond instrument is ultrasounded for 20 minutes individually in ultrasonic cleaning solution such as Pro Portion® (Sultan) in a reliable brand name ultrasound unit such as the Coltène Whaledent BioSonic® UC300 and then rinsed with water and ultrasounded again for 10 minutes with distilled water that the diamond is clean and ready for sterilization.

Reduced times of ultrasonic cleansing yields variable results where shorter times can clean (see F) and may also not completely clean (see G).

Baylor College of Dentistry did a comparison of ultrasonic unts and found that no unit sufficiently cleaned the rotary instruments, as evidenced by remnants of remaining blood and debris on the instruments. The loss of diamond chips was statistically significant for the instruments processed in the units ($P < 0.001$) ($P < 0.01$). (9)
Their data showed that the industrial-type unit was no more effective in cleaning dental rotary instruments than the conventional unit, though both units caused significant amounts of deterioration in the cutting surfaces. (9)

Rotary instruments after repeated sterilization are not recommended for the surgical operation to avoid the accident of breaking, because the priority should be given to patients' safety. (8)

During reprocessing, deterioration can occur on the cutting surfaces of some carbide and diamond instruments and after repeated reprocessing cycles. (10)
If you aren't already using single-use products, the above factors coupled with the knowledge that single-use rotary instruments may be more cost effective, may make the decision to consider using single-use more practical. (10)

Re-use of dental diamonds after repeated sterilization might be discussed from the standpoint of the economic efficiency and their material properties. (8)

Staff and clinician time to debride, cleanse, sterilize and reuse of diamond will involve

- Collecting diamonds
- Up to 30 minutes of ultrasounding,
- Handling sharp contaminated instruments
- Sorting out damaged and corroded diamonds
- Packaging
- Distributing re-sterilized diamonds
- Additional cutting time from reduced cutting rates (wear) (3)

It will only take 7-10 minutes for a typical $16/hour assistant to pay for one of the examined SS White Piranha Diamond or similar bur. This does not include the lost chair time of the clinician with diminished or unpredictable cutting rates from wear. Clinicians must answer the question of whether or not they prefer to pay an assistant and reuse a slower cutting diamond or use a fresh and predictable diamond every time. The expressing that "nothing tells a patient that you appreciate them more than a new diamond" appears to be correct!

It is the opinion of the authors as well as other authors that this time may be of more value than a $1.25-$2.00 diamond such as the examined SS White Piranha Diamond (8, 10).

The Electron Micrographs have demonstrated that the diamond instruments are not predictably cleansed by various ultrasounding times (9). Strict adherence to the 30 minutes of ultrasounding as set forth in this

article may not be practical or consistently followed in the clinical setting where time constraints are a daily consideration.

Is there a consistent and reproducible protocol for debridement and cleansing diamonds prior to effective sterilization? Yes, it is 30 minutes of ultrasounding. Is this protocol cost effective? Probably not.

It is the conclusion of the authors that the additional staff time for cleansing and sterilization, variable results in cleansing and the additional liabilities and risks involved in reuse of dental diamond may not justify reuse economically or clinically.

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Used dental burs may be contaminated with potentially pathogenic microorganisms.
Autoclaving alone fails to completely decontaminate burs.
Manual cleaning is not as effective as other methods of pre-sterilization cleaning. (1)

Instruments that have not been cleaned effectively cannot be sterilized. This is a fundamental maxim for sterilizing instruments**.** (1)

Great emphasis on the efficacy of routine cleaning prior to sterilizing of instruments to minimize the risks of transmission of infectious agents. (1)

Dental instruments and devices require sterilization (6). Surgery is the cutting of any of the body's tissues. Dentists and physicians generally use disposable surgical cutting instruments. Re-use of surgical cutting instruments requires meticulous and reliable debridement, cleansing and predictable sterilization. (6) The re-used surgical cutting instrument must remain sharp. The gradual reduction in cutting rate during repeated use is a result of diamond instrument wear. (4)

Differences in Cutting Rates for the three diamond instrument grit sizes are due to the greater decrease in Cutting Rates for the medium-grit diamond burs (50 percent) compared with the Cutting Rates of the coarse- and super-coarse-grit diamond burs (35 percent and 25 percent, respectively) over the total cutting period. (5)

Cutting efficiency also appeared to be dependent on debris accumulation between the diamond chips. (11)

The use and re-use of diamond burs in dentistry is examined in this article.

Used dental instruments (diamonds and carbides) may be contaminated with potentially pathogenic microorganisms.
Autoclaving alone fails to completely decontaminate rotary instruments.
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