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BioVAGE FACTOID

For added understanding of the clinical value of BioVAGE®, I encourage you to first read the PULP VESSELS, HÆMORRHAGE & DISINFECTANT HISTORY FACTOID articles for background information. The issues of cavity disinfection / soft tissue cleansing & hæmorrhage control of exposed dental pulps has been a major clinical concern ever since clinicians of the 1700's began to scrape-out soft debris from a decayed cavity with metal instruments—often causing traumatic pulp exposures.

In an attempt to remove infected caries, iatrogenic exposures often occurred that created a more severe clinical dilemma: **1**) to simply extract the tooth to prevent the probability of further pathology, **2**) to attempt soft tissue removal of the pulp, **3**) to attempt direct pulp-cap with an irritating or toxic agent e.g. asbestos, formaldehyde, phenol, arsenic, glutaraldehyde, which just prolonged the eventual tooth extraction.

THE PULP EXPOSURE SITE - Consider the traumatic events that occur when a sharp explorer tip or a bur ruptures through the dentine interface into the subjacent pulp—creating an accidental (iatrogenic) exposure. Several pathological events rapidly occur. Most burs rotate at several hundred thousand ultra-high rpm & as the bur breaks through dentine into the pulp, it destroys subjacent vessels, nerves, pulp cells & biofluids. In addition, the heat generated from the rotating bur easily inflicts thermal damage to odontoblasts, subjacent pulp cells as well as to damage vital bioproteins. With bur penetration, infected & affected dentine cutting debris chips—each chip contains millions of pathogenic bacteria that are pushed deeply into the vital pulp, where they will cause further pathological insult to the vital pulp tissues.

A number of ISO biocompatibility studies have shown that when dentine chips remain in the pulp following exposure & direct pulp capping, each chip serves as a nidus for reparative dentine formation—Stanley called "chipitis"—often leading to long-term pulp stone formation that later impinges on pulp nerves to cause patient pain. Another concern, most air compresser systems that drive handpiece turbines, are known to contain various bacteria that live along the walls of the water & air lines as permanent biofilm cultures—difficult to remove without elaborate chemical treatments. Additionally, oils from some compressors are sprayed to the bur head, which further contaminates the cavity walls of enamel, dentine & pulp tissues. If not removed, the

organic & inorganic debris will cause additional inflammation & compromise the bacteriometic restorative phase that is usually completed with an adhesive or ionomer system. If a complete mechanical & physiologically non-contaminated interface cannot be properly prepared before the restorative agents are placed, the long-term success of the bacteriometic interface is easily compromised & the definitive restoration is destined for failure. Dr. J. D. Ruby has recommended, a complete bacteriometic seal of the entire restorative interface is absolutely necessary for long-term clinical success of the restoration.

Since traumatic exposure events occur so fast, the clinician seldom realizes the dimension of the exposure. In searching the worldwide dental literature & US academic dental programs for a standardized clinical treatment procedure, it became apparent that most dental schools have their own preferred method to treat an exposed pulp. From my personal dental schooling & clinical experience at four-different US dental schools, each clinical program seems to have its own recommended lavage regimen—each often different from others. For example, one school recommended lavage with saline or a local anesthetic with epinephrine, to stop the bleeding, another taught their students to rinse the cavity with a chip-syringe & then place $Ca(OH)_2$ powder to dry the fluids, & yet another suggested to place a sterile cotton compress at the exposure site until the bleeding stopped.

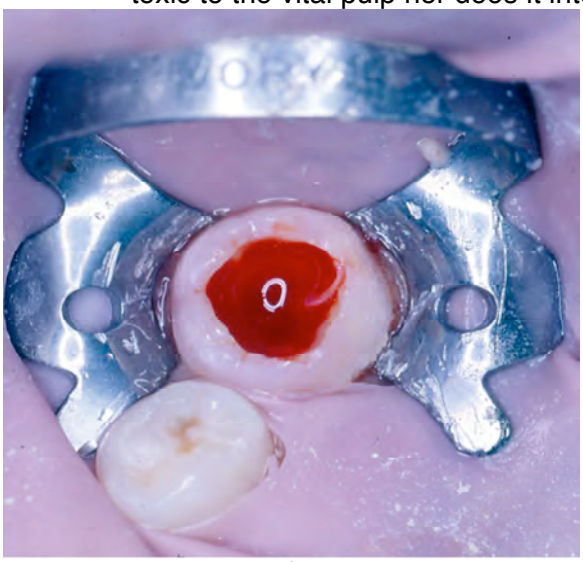
Thousands of *in vivo* biocompatibility studies have been published since Zander's first pulp study in 1947—sadly, it is incredible that certain US dental organizations & certain clinical specialties & the world wide academic community have not united to develop a common "gold standard" for treating the above mentioned exposure site complications. A 1987 *in vivo* biocompatibility study by Cox et al. reported that the exposed vital dental pulp will heal & form a dentine bridge in the absence of either Ca^+ or OH^- ions—developing a new dentine bridge directly adjacent to an acidic silicate or ZnPh cement & an auto cured adhesive resin.

Treatment of an accidental clinical pulp exposure during operative procedures, with no affected or infected dentine chips or salivary contamination to the subjacent pulp, then the healing capacity of the normal vital dental pulp & dentine bridge formation is very strong against a wide pH spectrum of capping agents. However, if the exposure

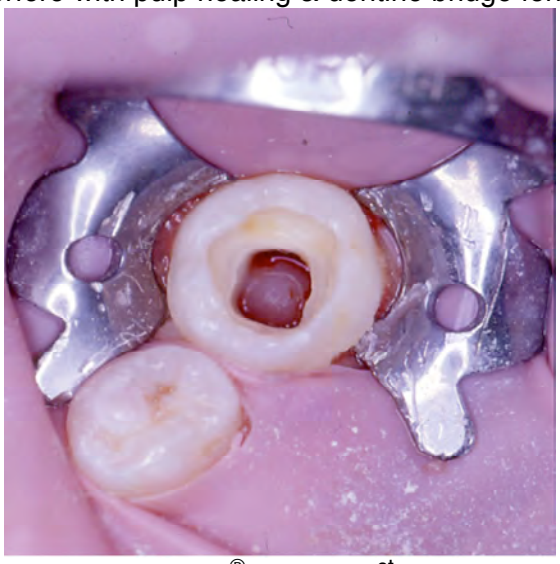
contains bacterially infected dentine chips & saliva contamination from poor rubber dam isolation, then ideal healing will most likely fail---especially if the various discussed issues above are not treated with proper cavity & pulp tissue lavage.

CAVITY LAVAGE - As reported in a number of publications & discussed in several FACTOIDS, it is evident that BioVAGE® will not impair or retard the cellular healing of exposed pulps. BioVAGE® has been demonstrated (Hafez 2000) to aid in the removal of all clot & cell debris & to completely stop hæmorrhage that compromises the healing process, as seen by the absence of coagulum & clot debris at the restorative interface after 7-days post capping. Published *in vivo* biocompatibility studies support the use of BioVAGE® to remove the dentine chips, which become pushed into the pulp during the mechanical exposure—eventually causing "chipitis" that leads to compromised dentine bridge mechanism. BioVAGE® is a unique antiseptic / disinfectant / hæmostatic agent formulated with medical grade reagents to provide complete lavage.

- Hæmorrhage control, the removal of the clot debris & dentine chips is critical for successful direct pulp capping.
- Application of BioVAGE® has been shown to be an efficient hæmostatic agent. It is not toxic to the vital pulp nor does it interfere with pulp healing & dentine bridge formation.



Pulpotomy on 1st molar



BioVAGE® treated 1st molar

The left frame shows extreme bleeding following removal of all infected dentine as well as the severely infected pulp tissue—down to the bifurcation of the canal pulp roots.

The right frame shows the remaining vital pulp & clean dentin wall after application of BioVAGE® to lavage & rinse the debris from the operative site. Please note there is no bleeding on the pulp-dentine wall interface—indicating the smear & blood debris are completely removed.

Bacteriometic sealed 1st molar
No hæmorrhage is seen along the restorative interfacial margin

Stainless steel Crown 1st molar

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