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DENTINAL SEALANTS: HOW AND WHEN TO USE SEALANTS TO TREAT UNCOMPLICATED CROWN FRACTURES

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In order to understand how and when to use dentinal sealants to treat uncomplicated crown fractures, an understanding of the important relationship dentin has with the pulp and enamel must be achieved.

Dentin is a porous, hard organic (30%) and inorganic (70%) substance that is covered by enamel (crown) and cementum (root). Unlike enamel, dentin is continually made through out the life of the tooth. Although it appears grossly as a solid structure, microscopically dentin is made of three structures: *dentinal tubules* that extend to the pulp, *intertubular* dentin that makes the bulk of dentin and peritubular dentin that has a higher crystalline content than the intertubular dentin. The dentinal tubules contain *odontoblastic processes* from odontoblasts located within the pulp. Nerve fibers, specifically A-Delta fibers, are wrapped around odontoblasts.

Odontoblasts are cells that form new dentin. There are three types of dentin: *primary dentin*, which is the dentin that is present when the tooth erupts, *secondary dentin*, which is the new dentin laid down as the tooth ages and *tertiary dentin*, which is reparative dentin. Tertiary dentin is less organized than secondary or primary dentin and appears brown and shiny. This dentin is laid down when there is injury to the tooth such as from chronic wear (ball chewing) or after an uncomplicated crown fracture.

Dentin is composed of tubules that connect the pulp to the enamel. The dentinal tubules contain fluid, nerves and odontoblastic processes. This means that dentin and the pulp have an integrated relationship; therefore, damage to the dentin affects the pulp and damage to the pulp affects the dentin. This is why the pulp canal is wider in non-vital teeth compared to the other dentition and the reason why uncomplicated crown fractures can result in pulp necrosis.

There are three afferent nerves that are responsible for odontogenic (tooth) pain: A-Beta, A-Delta and C-fibers. A-Delta fibers are stimulated when dentin is exposed to changes such as temperature, osmolality (sweet or salty foods) or external stimuli touching dentin (eating/ chewing toys). This results in fluid movement within the dentinal tubules and movement of the odontoblastic processes and stimulation of the A-Delta fibers within the pulp, resulting in *PAIN*.

Dentinal tubules are greater in number and larger in diameter the closer they are located to the pulp. Clinically, this means that the deeper the fracture, the more dentinal tubules are exposed to the oral cavity/bacteria. The more dentinal tubules exposed, there is a greater potential for pain and increased risk for pulp necrosis. Dentinal tubules provide a conduit for oral bacteria to have direct access to the pulp, which could cause irreversible pulpitis and pulp necrosis.

Uncomplicated crown fractures need to be treated because they could cause pain and/or infection resulting in tooth death. The treatment protocol will depend on which tooth is fractured, how the tooth is fractured, the depth, and the location.

For example, superficial slab fractures on the buccal aspect of the fourth premolar are good candidates for sealant alone (as long as the tooth is vital) but deeper fractures at this location might require a true "restoration" with composite. The most common fractures that are treated with a sealant are: uncomplicated fractures involving the cusps of the premolars or mandibular first molars, teeth treated with odontoplasty and in cases of hypoplastic enamel treatments (enamel hypocalcification/hypoplasia).

Examples of when to not use sealants are: non-vital teeth, teeth with resorptive lesions affecting the crown, teeth with complicated crown fractures or caries lesions. Sealants are also not permanent and might need to be replaced in the future. The frequency of re-application depends on the chewing habits of the patient and if reparative dentin is present (typically do not seal if tertiary dentin is present). Treated teeth need to be radiographically monitored to ensure that the tooth has not died. This can results due to an inadequate seal, pulpitis present prior to procedure or secondary to the initial insult (contusion resulting in tooth death).

Odontoplasty is defined as an adjustment of the tooth contour. This procedure needs to be performed prior to sealing fractures but sometimes this procedure is performed as a primary treatment. For example after extraction of the maxillary fourth premolar in dogs and cats the cusps of the mandibular first molar are "flattened" and "rounded" in a manner that would prevent the cusps from traumatizing the opposing hard palate when the tooth contacts the tissue. The tooth contacting the hard palate is a result of the extraction of the opposing fourth premolar. The "contouring" of this tooth is referred to as an odontoplasty. Whenever this procedure is performed enamel is removed potentially exposing dentin thus requiring to be sealed.

To prepare a fracture site or hypoplastic enamel for dentinal sealant the recipient site should have all of the unsupported enamel/dentin removed and then contoured (odontoplasty) to prevent future fractures, plaque retention and allow better retention of the sealant. Typically diamond burs, fine or medium course tapered diamond burs are recommended. A favorite is a "football" shaped diamond bur, which allows excellent contouring. After the odontoplasty the tooth should be cleaned, smear layer removed and dentinal tubules "opened", which can be achieved with acid etchants.

The most common acid etchant used in dentistry is phosphoric acid at a 37-38% concentration. This acid is typically not irritating to soft tissue, but protection of the gingiva is recommended (gauze wrapped around the tooth works well). The etchant should sit on the tooth between 15-30 seconds (please adhere to manufacturer's recommendation) and then rinsed (wiping the etchant off the tooth with water soaked gauze works very well). The area should look "chalky". If it does not, then this step should be repeated. Etchant should only be applied to the recipient site, and unaffected enamel should not be etched because it will cause it to demineralize.

After the etchant has been removed, the tooth should be blotted dry with a cotton pellet or gauze. Once the tooth is dried, 2-3 consecutive coats of the sealant should be applied for 15 seconds with gentle agitation while using a fully saturated brush to the prepared site. Gently air dry for 15 seconds to remove the solvent and thin the layer of the sealant. This can be performed with a 3-way air-water syringe. To prevent oil from being blown onto the tooth from the syringe, it is recommended to "push" the air button on the syringe away from the tooth, and then without letting go of the button, to move the syringe over to the tooth. The oil from the syringe will be expelled prior to drying the tooth. After evaporation of the solvent, the area should be light cured for 15-30 seconds (please refer to manufacturer's recommendations).

There are 7 dentinal sealant/adhesive generations present on the market. The most commonly used for this procedure are 5th generation. These dentinal sealants contain the primer and adhesive in one bottle. Our favorite at Pacific Coast Veterinary Dentistry is 3M ESPE Adaper Single Bond; it is a more expensive product but has proven in our hands to work superior to other generic/cheaper brands.

It is very important to treat uncomplicated crown fractures because if left untreated, it could lead to the death of that affected tooth and/or dental pain. It is also essential to recognize which teeth are and are not good candidates for this treatment.

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