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CERAMIC RESINS AND TOOTH SENSITIVITY
PART II
by Murray J. Vimy, D.M.D., F.A.G.D.

INTRODUCTION:

In the previous newsletter we addressed some of the possible etiological factors of pulpal pathosis following posterior resin placement. In this report we would like to review one specific approach to this problem. This approach and the research substantiating it have been developed by Dr. Martin Brannstrom, associate professor of Oral Pathology and Docent in Experimental Histopathology at Karolinska Institute, School of Dentistry, Sweden.

Dr. Brannstrom is one of the major proponents of the "Theory of Hydrodynamics". According to this theory the pulp has a gradient of fluid pressure directed from the pulp outwards through the dentin and the enamel. This gradient is due to the higher fluid pressure in the pulp. According to Johnson et al. 1973, an open odontoblastic tubule if left unprotected would theoretically empty itself 10 times a day.

Other research has shown that fluid flow from the pulp may be outward or inward, depending upon environmental factors.² Dr. Ralph Steinman, now professor emeritus at Loma Linda School of Dentistry, demonstrated that pulpal fluid under normal physiological conditions flows outwards from the pulp, through the dentin, and through micropores in the enamel. His studies, which have not received the attention they are due, utilized a dye tracer injected into rats. Various nutritional factors were altered and the teeth were sectioned and the dye patterns observed. According to the research there is a hypothalamic/paratoid endocrine axis. This hormonal axis triggered by the nutritional factors causes the parotid gland to release a hormone which reverses the natural direction of pulpal fluid flow. Interestingly, one of these nutritional factors is sugar.

Nature has given the tooth a natural protective mechanism.

The outward fluid flow is especially evident in tooth areas where secondary dentin has not been formed. According to Brannstrom's research, sensitivity is created when mechanical stimulation removes fluid from the tubule ends which are exposed.

This removal increases capillary forces and the once slow fluid movement increases. Further, this increased fluid flow activates mechanoreceptors at the end of the dentinal tubules and results in pain. Sensitive dentin indicates tubules that are open to the pulp and which are exposed to mechanical irritation. If the exposed dentine is kept wet, the flow decreases and the pain dissipates.³

The autocure ceramic resins set slowly. Consequently, droplets of pulpal fluid can collect under the restoration. This is especially true if the dentin has been exposed to acid or strong chelating agents which remove the smear layer and open up the ends of the odontoblastic tubules.

Further, most of these types of resins contract during setting and create a gap (5-20 micrometers) between the tooth and the material. If saliva or other fluids are present they get pulled into the gap by capillary forces. Once the gap₄ becomes filled with pulpal fluid, the slow outward movement continues.

With time, other factors slow the fluid flow. These are:

- 1) accumulation of solid materials,
- 2) delayed expansion of the filling and
- 3) a calcified pellicle which may form.

This outward fluid flow does not, in Brannstrom's opinion, inhibit chemical gradients which may be directed inward. Thus, sugar molecules on the outside could diffuse through the gap and reach bacteria under the restoration.

He makes the following points:

"Leakage, that is, the diffusion of particles inward, does not, except for sugar and possibly acid, seem to have much clinical relevance.....I have not seen any experimental evidence that bacterial toxin....may exist at the tooth surface and at the margin in concentrations great enough to reach the pulp....Nor can I imagine how variations of intraoral temperature, which are usually of short duration and within the normal range, can have a significant influence on the outward flow of fluid around the filling."⁵

Brannstrom's opinion based on his research and review of the literature is that the most significant factor causing pulpal irritation is INFECTION IN THE GAP. Even a few bacteria may multiply in the gap and reach thousands within 10 days.³ Consequently toxins are concentrated in the₆ gap and irritate the pulp. These bacteria can enter dentinal tubules.⁶

Further, they may multiply from the smear layer even if the communication with the oral cavity is sealed.

He concludes very emphatically:

"The results (of all the research) have pointed to the same conclusion, namely: when infection is avoided there is no appreciable irritation to the pulp; pulpal damage is caused by infection and not by the filling material or the pretreatment procedures."^{5,8}

This conclusion is a dramatic departure from the notions of most practicing dentists. However his research evidence is compelling.

Other conclusions of Brannstrom's research:

- 1) acid etching even near the pulp does not irritate the pulp.^{9,10}

2) irrespective of the materials used there is no pulpal inflammation as long as there is no infection under the fillings. This is true even for dental amalgam.¹¹

3) dentine is a good insulator. Therefore, there is no need to place insulating cements under amalgam.¹²

4) Zinc oxide and eugenol is the only material that appears to cause pulpal inflammation.¹³

TECHNIQUE RECOMMENDATIONS ACCORDING TO BRANNSTROM

To avoid infections under the filling:

- 1) the cavity must be clean
- 2) a lining must be placed on all walls to prevent bacterial invasion.
- 3) a lining must be attached to all dentin so that the bacteria can not get a place to multiply especially in the open odontoblastic tubules.

To eliminate sensitivity:

- 1) where possible caries should be removed without anesthetic. Sensitivity when excavating indicates tubules open to the pulp.
- 2) when sensitive teeth are encountered while removing the caries the teeth should be medicated with a temporary dressing to stimulate secondary dentin formation and this reduces sensitivity.
- 3) a temporary dressing containing calcium hydroxide is excellent in reducing tubule infections.

However, the use of thick bases is discouraged because:

- 1) They don't always adhere,
- 2) They can not be placed on all walls,
- 3) They, are difficult to use on small shallow cavities,
- 4) They can impair the retention of the final restoration and
- 5) If there is leakage they can dissolve leaving a significant gap.

PROCEDURES:

Before the tooth is lined all the superficial smear layer must be removed. The superficial smear layer is everything except the plugs in the dentinal tubules. Further, an antiseptic is needed to remove all the microbes present. Strong solutions such as acid or 15% EDTA are not good because they remove the tubular plug and open up the tubules.¹⁴