

## THE ROLE OF VOLATILE SULFUR GASES ON THE INCREASED PERMEABILITY OF THE PERIODONTAL LIGAMENT ATTACHMENT APPARATUS

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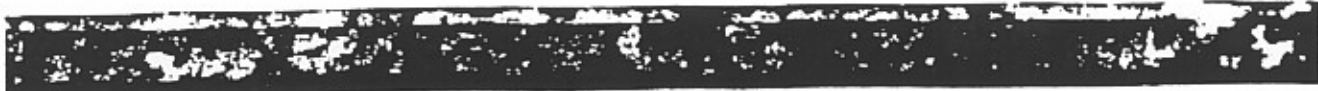
*It is the purpose of this paper to explore the increased permeability of the periodontal ligament attachment apparatus caused by volatile sulfur gases and the reduction of these gases by the application of chlorine dioxide which oxidizes the sulfur bond.*

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In the past twenty-five years we have seen a dramatic shift in the focus of dentistry from reducing tooth loss through caries to an aggressive approach to maintaining teeth in the face of a threat from periodontal disease. Over the years there has been a plethora of research, theory and treatment proposals on the subject of periodontal disease. To be sure, the presence of bacteria plays an integral part in the progress of the disease phenomena, but one must ask, "When is the line crossed between health and disease?"

Normal, healthy, intact gingival tissue creates an effective barrier against the toxins that would normally cause inflammation in that tissue. In the normal process of epithelial cell metabolic activity a constant renewal process takes place. Studies of healthy individuals have shown that sulcular and junctional epithelial cells have a turnover or replacement rate of 2 to 4 days. In the presence of gingival inflammation, the epithelial replacement takes place at a much more rapid rate. It has been demonstrated that the cell replacement rate can increase eight times the normal rate creating a turnover in as little as six hours. The process results in a debris composed of dead cell walls, flagella, pili, and fimbriae. Chemically, this debris is made up of polypeptide chains.<sup>6</sup>

Of special interest is the fact that these polypeptides are the major contributing factor in halitosis.<sup>4</sup> One only has to be near a person with halitosis to know that something is going awry in that person's chemistry. While halitosis is significant from a social standpoint, it may be even more significant in the periodontal breakdown process.<sup>1</sup> Researchers have analyzed the gases in the halitosis patient and have found them to be composed of three compounds. They are hydrogen sulfide, methyl mercaptan and dimethyl sulfide. The compounds have been ascribed the name volatile sulfur compounds (VSC) or gases and are characteristic in everyone's breath at one time or another but predominant in the breath of an individual starting periodontal breakdown.<sup>2,3</sup>



The by-products of epithelial and bacterial metabolism are generally regarded to be the causative factors in initiating periodontal breakdown. It is believed that they change the structure of the crevicular epithelial barrier resulting in an increased permeability. This allows bacterial toxins to pass through the otherwise intact epithelium and deleteriously effect the underlying connective tissue. Numerous studies have been done on the permeability of the periodontal ligament attachment apparatus.<sup>5</sup> VSC's have been shown to be the reason for this increased permeability. Eighty percent of the content of VSC's in mouth air is composed of hydrogen sulfide and methyl mercaptan.<sup>2</sup> As the severity of periodontal breakdown occurs, the presence of VSC's increases.<sup>7</sup> VSC's have been shown to be responsible for interfering with normal collagen maturation in connective tissue. It has also been demonstrated that VSC's stimulate cytokine production indicating that they can activate the immune system to produce collagenolytic enzymes.<sup>8</sup>

The periodontal tissues remain healthy in an atmosphere where cell biology creates continual cellular renewal and death. If VSC's reach a great enough concentration, permeability of the periodontal ligament attachment apparatus increases. As permeability increases, a more rapid replacement of cells takes place which produces more cell debris. As this cell debris putrefies, more VSC's are produced affecting the collagen. The process results in pocket formation and, as pocket depth increases, more VSC's are produced.<sup>9,10</sup> And so the downward spiral continues.

Dentistry's efforts have been toward interrupting this cycle by several approaches:

- a. Mechanical intervention.
- b. Antibiotic intervention.
- c. Chemical intervention.

All of these modalities have been discussed in detail in other forums and literature.



In addition to these new modalities, a new approach is in order through reducing the volatile sulfur gases which should then protect the barrier effect of the periodontium. Studies have shown that the sulfur molecule can be affected by an oxidation-reduction reaction in which the sulfur bond is oxidized. One of the safest yet most powerful oxidizers available is chlorine dioxide ( $\text{ClO}_2$ ).<sup>11</sup> In its natural state it is a volatile gas. Technology has developed a way to stabilize  $\text{ClO}_2$  in an aqueous solution. It has been used by industries for years as a disinfectant and deodorizer. The reaction of hydrogen sulfide, expressed as the sulfide ion, with chlorine dioxide is as follows:



The reaction of methyl mercaptan with  $\text{ClO}_2$  is as follows:



A pharmaceutical grade of  $\text{ClO}_2$  has been developed under the name of OXYGENE and is the principal active ingredient in a family of dental products (mouthrinse, toothpaste, and a topical gel).<sup>\*</sup> OXYGENE is transformed from its stabilized form to an active one by exposing it to the acids of the saliva. The reaction creates a powerful deodorizing effect in which the volatile sulfur gas is eliminated rather than just covered over with a more powerful perfume.

This paper proposes that:

- a. VSC's are precursors in the breakdown process of the periodontal ligament attachment apparatus.
- b. Chlorine dioxide is a known oxidant of the sulphur containing molecule.
- c. Regular use of oral products containing chlorine dioxide will interrupt the breakdown process by eliminating the VSC's.

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