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## Periodontal Disease and the Return of Systems Thinking

For much of the past century, medicine and veterinary medicine have been dominated by a largely reductionist understanding of disease. Disorders are separated into categories, assigned discrete causes and treated as though biological systems behave like machines with isolated faulty components. This approach has undoubtedly delivered important advances, particularly in surgery, trauma care and infectious disease control. Yet it has also imposed intellectual limitations that become increasingly apparent in the study of chronic inflammatory disease.

Periodontal disease is one such example.

Conventionally, periodontal disease is described as a local process initiated by plaque accumulation, followed by bacterial colonisation, inflammation and tissue destruction. The model is linear: plaque leads to gingivitis, gingivitis progresses to periodontitis and tissue breakdown follows. Treatment correspondingly focuses on removing deposits, suppressing bacteria and repairing damage.

However, despite decades of increasingly sophisticated interventions, periodontal disease remains among the most widespread chronic inflammatory conditions affecting both humans and companion animals. Moreover, mounting evidence now links periodontal inflammation with systemic disorders including cardiovascular disease, diabetes, kidney disease and cognitive decline. The oral cavity can no longer be regarded as biologically separate from the wider organism.

These realities raise an uncomfortable question: what if the prevailing conceptual framework is incomplete?

Recently, the *Journal of Periodontal Research* published a paper by veterinarian, Dr Tom Lonsdale, titled "[Periodontal Medicine and the Limitations of Linear Causality: Time for a Cybernetic Framework.](#)" The paper revisits ideas first formulated more than three decades ago in what became known as the [Cybernetic Hypothesis of Periodontal Disease in Mammalian Carnivores.](#)

At its core, the hypothesis proposes that periodontal disease is better understood not as a simple local infection but as a disturbance within a complex adaptive system governed by feedback regulation. Under natural evolutionary conditions, mammalian carnivores maintained oral health through behaviours and diets integrated with the ecology in which they evolved. Teeth, gums, saliva, immune responses, oral microbiota, diet and environmental pressures formed part of a dynamic self-regulating system.

Modern industrial conditions profoundly altered that relationship.

In companion animals, the widespread replacement of natural diets with ultra-processed pet foods changed chewing behaviour, oral mechanics, microbial ecology and metabolic regulation simultaneously. Similar questions may reasonably be asked of ultra-processed diets in human populations. The consequences are unlikely to arise through one isolated pathway alone. Rather, they emerge through multiple interacting feedback loops involving inflammation, immunity, microbiomes, endocrine signalling and behaviour.

This is where cybernetics becomes relevant.

Cybernetics, a field developed in the mid-20th century by thinkers such as Norbert Wiener, studies regulation, communication and feedback in complex systems. It recognises that systems may stabilise themselves under some conditions yet spiral into amplification and dysfunction under others. Importantly, cybernetic systems are not strictly linear. Causes and effects continually interact.

In biological systems, inflammation itself may become self-reinforcing. Once chronic inflammatory states are established, tissues, immune responses, microbial populations and systemic mediators influence one another continuously. The old distinction between “local disease” and “systemic disease” begins to dissolve.

Recent advances in microbiome science, systems biology and inflammatory medicine increasingly support this broader perspective. Researchers now routinely discuss bidirectional relationships between periodontal disease and systemic illness. The language of networks, regulation and biological ecosystems is steadily replacing older mechanistic assumptions.

None of this means traditional periodontal research is worthless. On the contrary, decades of careful microbiological and clinical investigation remain essential. But facts interpreted within one conceptual framework may acquire entirely different meaning when viewed within another.

Scientific history repeatedly demonstrates this pattern.

Thomas Kuhn, in *The Structure of Scientific Revolutions*, observed that dominant paradigms tend to persist even when anomalies accumulate around them. Established institutions, educational systems and professional incentives naturally favour continuity. New frameworks often emerge gradually and initially at the margins, especially when they challenge deeply embedded assumptions.

Veterinary medicine is not exempt from these wider sociological realities.

For decades, commercial influences have also shaped nutritional narratives within companion animal medicine. The rise of industrial pet food coincided with increasing prevalence of chronic dental and degenerative disease in domestic animals. Yet these relationships have rarely received the level of critical scrutiny they deserve. Questions concerning diet, oral health and systemic disease remain entangled with commercial interests, educational orthodoxies and institutional inertia.

Nevertheless, the intellectual climate may be changing.

The growing scientific interest in microbiomes, ecological medicine and chronic inflammation suggests a broader transition may already be underway. Increasingly, researchers recognise that living organisms cannot always be understood through isolated variables alone. Biological systems are nested within wider biological and environmental systems. Health itself may be less a static condition than a dynamic process of ongoing regulation and adaptation.

This has implications extending well beyond dentistry.

If chronic inflammatory diseases are fundamentally systemic and feedback-driven, then prevention assumes far greater importance than symptom management alone. Diet, behaviour, environment and ecological context become central considerations rather than peripheral lifestyle factors. The distinction between medicine, nutrition and ecology becomes less rigid.

Importantly, a cybernetic perspective also encourages humility.

Complex systems rarely yield simple monocausal explanations. Interventions may produce unintended consequences. Treatments that suppress one process may destabilise another. The ambition should not be domination of biological systems, but better understanding of how regulation is maintained — and how it fails.

The publication of the recent *Journal of Periodontal Research* paper does not “prove” the Cybernetic Hypothesis in any final sense. Science does not advance through declarations of certainty. Rather, the publication signals that ideas once regarded as peripheral are again entering legitimate academic discussion.

That alone matters.

At a time when chronic inflammatory disease affects humans, pets and ecosystems alike, there is growing need for conceptual frameworks capable of integrating rather than fragmenting knowledge. Linear models remain useful, but they may no longer be sufficient.

The future of medicine may depend less on discovering ever more isolated mechanisms than on understanding how living systems regulate themselves across multiple interacting levels.

In that sense, the renewed discussion of cybernetic approaches to periodontal disease may represent something larger than a debate about teeth and gums.

It may reflect the slow return of systems thinking itself.