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Oral Biofilm Producing Reactive Oxygen Species: Leading to Inflammation and Cancer

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Dental plaque, or oral biofilms, are complex microbial communities that grow on tooth surfaces and other oral structures. Microorganisms like bacteria, fungi, viruses, and others live in these biofilms' extracellular polymeric matrix[1]. Some oral biofilm bacteria release Reactive Oxygen Species (ROS) during metabolism. ROS molecules include superoxide (O_2•−), hydrogen peroxide (H_2O_2), and hydroxyl radicals (•OH). ROS from oral bacteria can be good or bad. ROS are essential to microbial defence and other physiological and pathological functions.

Electrons can leak from the electron transport chain during aerobic respiration, forming superoxide radicals. Some bacteria have enzymes like superoxide dismutase and catalase that transform reactive oxygen species into safer molecules[2]. Additionally, certain pathogenic bacteria create ROS to alter host immunological responses. Bacteria that generate ROS can cause oxidative stress in host cells, altering signalling cascades and causing inflammation. This may help bacteria avoid the host's immune system or advance infection. Bacterial physiology, host-pathogen interactions, and treatment methods against bacterial infections depend on understanding reactive oxygen species generation and detoxification.

However, excessive production of ROS can lead to oxidative stress, causing damage to host tissues. This oxidative stress is associated with oral diseases, including periodontitis and gingivitis. ROS can trigger inflammatory responses in the oral tissues, contributing to the progression of inflammatory conditions[3,4].

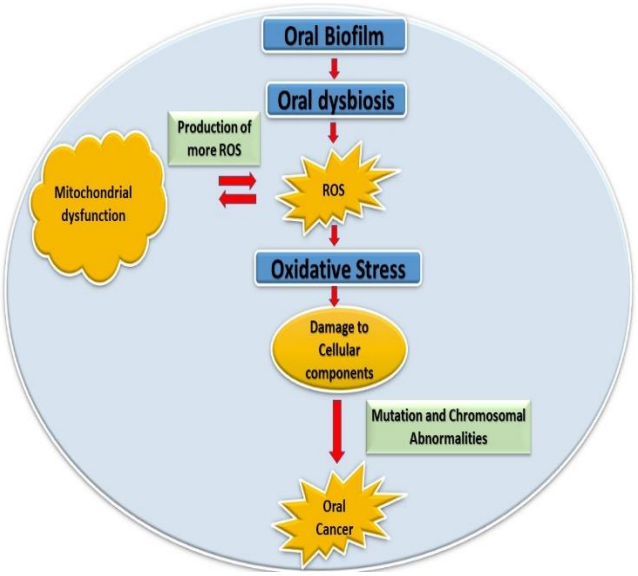

Figure I: Pathway Leading to Oral Cancer from Oral Dysbiosis

An imbalance between ROS production and cell detoxification can cause oxidative stress, which is linked to various illnesses, including cancer. ROS have been linked to oral cancer onset and progression. ROS destroy DNA and other biological components[3]. Mutations and genomic instability, which cause cancer, particularly mouth cancer, can result from DNA oxidative damage. ROS participate in cell signalling pathways.

Overactive ROS can activate signalling pathways that increase cell proliferation, survival, and angiogenesis, promoting cancer cell development[4]. Cancer, especially oral cancer, is linked to chronic inflammation. Prolonged inflammatory conditions can cause cancer due to ROS production.

Furthermore, mitochondria produce most cellular ROS. Dysfunctional mitochondria produce too many ROS, causing oxidative stress and cell damage[5].

The body's antioxidant defences neutralise ROS and maintain cellular equilibrium. These defences may be overcome in chronic inflammation or other stressors, causing ROS build-up. ROS is involved in cancer, particularly oral cancer[6,7]. Hence, researchers are studying ways to reduce ROS levels in cancer cells. This includes developing antioxidant medicines, nanoparticles and compounds targeting cancer cells by leveraging their vulnerability to oxidative stress[8]. ROS are involved in cancer formation and crucial to regular cellular activities. ROS generation and cellular antioxidant defence mechanisms must be balanced. Researchers are studying ROS's complex involvement in cancer and developing targeted medicines to treat mouth and other cancers.

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Conflict of Interest
The authors have no relevant conflicts of interest to declare.

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