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Relation to the Variety of Unsaturated Fatty Acid and Age Related Alveolar Bone Resorption

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Abstract: *Aging enhances susceptibility to chronic diseases like, respiratory disorder, cardiovascular diseases or periodontitis. More recently, research has established to include nutrients shown to attenuate the inflammatory process or to have anti-inflammatory properties, like some omega-3 series fatty acids and omega-6 series fatty acids known as polyunsaturated fatty acid (PUFA). It is observed that the enhanced alveolar bone loss associated to age may be treated by an appropriate PUFA rich dietary fat. However, report says that virgin olive oil which is monounsaturated fatty acid (MUFA) rich or PUFA rich fish oil (omega-3 series) prevent age-related alveolar bone resorption .*
KeyNotes: *Alveolar bone, Omega-3 fatty acid, Omega-6 fatty acid, PUFA, MUFA*

I. Introduction

Extensive research has been done on age related chronic diseases like diabetes, cancer, cardiovascular and neurodegenerative diseases and also periodontitis. An experiment demonstrated an age- dependent model of the periodontium, which is a fully physiological approach to the periodontal conditions, with the impact of the nature of dietary fat on periodontal tissue conditions [1]. Generally, the dietary fat contains variable amount of unsaturated fatty acids which are mainly MUFA (Monounsaturated fatty acids) and PUFA (polyunsaturated fatty acids). Monounsaturated fatty acids, like oleic acid (18:1n9) and palmitoleic acid (16:1n7), are metabolized to form independent families through desaturation and chain elongation [2] .The essential fatty acids (EFAs) are polyunsaturated fatty acids (PUFAs) namely linoleic acid (18:2n-6, LA), at the origin of the omega-6 series, and alpha-linolenic acid (18:3n-3, LnA), giving rise to the omega-3 series (Fig.1). The mammals can not synthesise EFA in their system. LA and LnA are precursors of eicosa- noids [synthesized via cyclooxygenases into prostaglandins (PG) and thromboxanes, and via lipoxygenases into leukotrienes (LTs) and eicosapentaenoic acid, respectively]. EFAs are incorporated into cell membrane phospholipids, thereby influencing the conformation, mobility, and function of membrane-bound proteins and regulating membrane microviscosity or fluidity [2,3].

Omega-3 fatty acids in diet offer benefits by reducing the incidence and severity of inflammation, cardiovascular diseases and sometimes cancers in humans [4,5]. Populations consuming omega-3 series fatty acids rich diet, have a low incidence of atherosclerotic disorders [6]. Fish oil, which is rich in eicosapentaenoic acid (EPA, 20:5n-3) and docosahexaenoic acid (DHA, 22:6n-3), was shown to reduce myocardial ischemic damage and ventricular fibrillation [7]. The antitumorigenic effect of omega-3 series fatty acids was established in some cancer like, breast cancer [8], colon cancer [9], and pancreatic neoplasm [10]. In the past few years it has been shown that some antioxidants, as well as some dietary fats, may also be used as dietary anti-aging therapies [11,12].

In the present study, we selected three kind of dietary fats having different unsaturated fatty acid composition: i) MUFA rich olive oil, PUFA rich oils like ii) fish oil (omega-3FA rich) and iii) sunflower oil (omega-6 FA rich). Our study aims to find the relation to omega-3FA and omega-6FA rich dietary oils and their action on alveolar bone resorption with aging.

II. Discussion

Periodontitis is a disorder happened by the breakdown of the tooth-supporting tissues, mainly alveolar bone loss. It is related to age and this condition is due fundamentally to an imbalance between the normal microbial biofilm on teeth and the host tissues [13]. There are many evidences linking periodontitis to systemic diseases like atherosclerosis also [14].Potential common link between risk factors for cardiovascular diseases and periodontitis with oxidative stress may be explained by metabolic dysfunction, a common clinical entity [15,16]. The effect of diet on periodontal diseases is very much well established where only a few nutrients have enormous roles in the formation and maintenance of structural components of oral tissue such as collagen

(vitamin C) and bone (calcium), integrity of epithelial tissue (vitamin A), or in promoting the formation of plaque that harbors periodontal pathogens mainly carbohydrates.

Studies show that dietary fat changes membrane-lipid profiles and help to attenuate some deleterious aspects of aging, such as those related to exacerbated oxidative stress or mitochondrial dysfunction [17-20]. It has been shown by an experiment where animals were fed life-long on diets based on monounsaturated fatty acids (MUFA) as virgin olive oil, n-6 polyunsaturated fatty acids (omega-6 PUFA), as sunflower oil, or n-3(omega-3 PUFA), as fish oil (the fatty acid composition of above three oils is shown in Table 1). The observation shows that alveolar bone loss was higher in n-6 PUFA fed rats. The fact may be explained by the way that MUFA or n-3 PUFA allowed mitochondria to maintain an adequate turnover through induction of biogenesis and the antioxidant systems, and thus avoiding mitochondrial dysfunction. Moreover, the mechanism of action may be related with an ablation of the cell capacity to adapt to aging and might also be able to induce the corresponding antioxidant systems to counteract age-related oxidative stress, and do not inhibit mitochondrial electron transport chain. Moreover, MUFA rich diets showed less damage in mitochondria during aging than that of n-6 fed diets, as reflected by a lower frequency of mt DNA (mitochondrial DNA) deletions at the liver, heart and brain [17,20].

Moreover, rats infected with P. gingivalis were fed fish oil (n-3 FA) or corn oil (n-6 FA) diets for 22 weeks. It was observed that rats on the n-3 FA diet exhibited elevated serum levels of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA . It was observed that rats, orally colonized by P. gingivalis increased IgG antibody levels substantiated this infection and P. gingivalis-infected treated with n-3 FA had significantly less alveolar bone resorption. Omega-3 EPA and DHA may play critical roles in health through hormonal and structural mechanisms. These findings demonstrated [21] the effectiveness of an n-3 FA supplemented diet in modulating alveolar bone resorption following P. gingivalis infection, and supported that n-3 FA may be a useful adjunct in the treatment of periodontal disease.

An investigation was done on the dietary ratio of (n-6)/(n-3) fatty acids and tissue PGE2 production and bone formation in growing animals. The fatty acid composition of bone compartments and ex vivo bone PGE2 production were noted. scientists [22]explained that the action of n-3 FA fatty acids is mediated in part by decreasing the production of PGE_2 and perhaps by down-regulating cyclooxygenase-2 (COX-2) activity in local tissues. The prostanoid PGE_2 plays an important role in bone metabolism by modulating the dietary ratio of (n-6)/(n-3) fatty acids and thus the bone growth could be optimized during bone modeling.(Fig.2) However, limited research has been performed on the putative role of other well-documented healthy fatty acids such as MUFA which is major fatty acid in virgin olive oil. The main finding is that the enhanced alveolar bone loss, a feature of periodontal disease, associated to age may be targeted by an appropriate dietary treatment. Diets based on virgin olive oil (MUFA rich) or PUFA rich fish oil omega-3 series may prevent age-related alveolar bone resorption .

In addition, from the nutritional and clinical point of view, it may be mentioned that the potential treatments to attenuate alveolar bone loss associated to age could be similar to prevent cardiovascular diseases.

Table 1: Fatty acid composition of dietary oils

Major fatty acids (% w/w)			
Fatty acids	SFA (Saturated fatty acid)	MUFA (Monounsaturated fatty acid)	PUFA (Polyunsaturated fatty acids)
Sunflower oil	11.0	30.0 (omega-9 FA)	59.0 (omega-6 FA) (Major FA 18:2)
Olive oil	15.0	70.0(omega-9 FA)	15.0(omega-6 FA) ((Major FA 18:2)
Fish oil (Marine fish)	35.0	28.0 (omega-9 FA)	33.9 (omega-3 FA) 2.4 (omega-6 FA) (20:5 -18.5% & 22:6 - 12.3%)

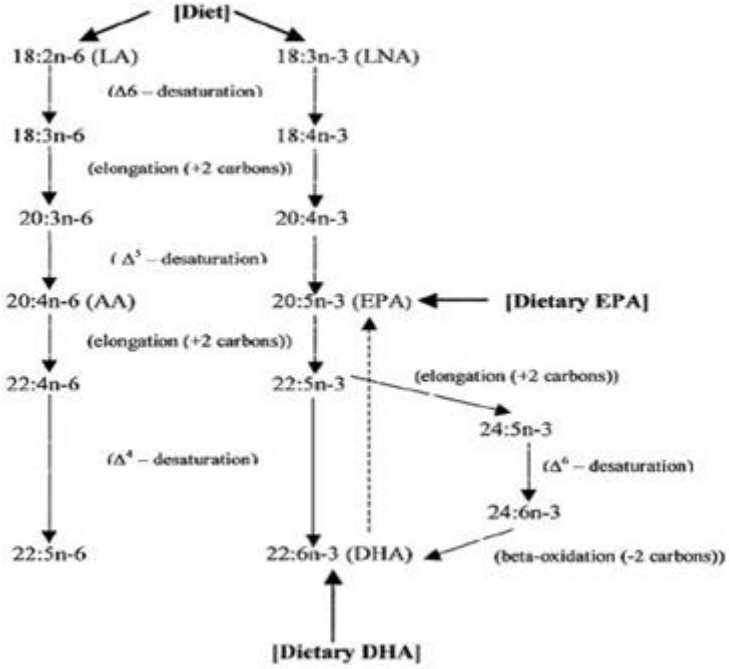

Figure 1: Essential fatty acids, desaturation , elongation, and retroconversion of omega-6 and omega-3 polyunsaturated fatty acids

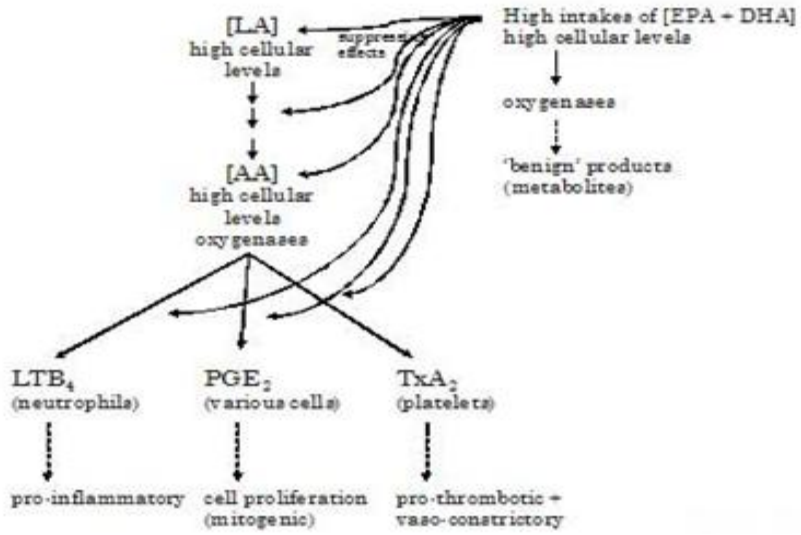

Figure 2: Oxygenase-derived metabolites (eicosanoids) from AA (n-6)

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