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Review article

The Role of Optimized Diet in Periodontal Health Maintenance

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Abstract

Food habits have almost a direct link to maintaining a good oral hygiene. Diet and nutritional health are thought to be as modifiable lifestyle risk factors for the development of periodontal disease. Latest studies have shown about the developed food habits, distinguished majorly by convenience foods (processed carbohydrates such as sugar and plain flour, elaidic acids and low micronutrient densities), might be involved in promoting periodontitis. On the other hand, low blood glucose and compound carbohydrates (found in vegetables, fruits and legumes), polyunsaturated fatty acids, microelements such as vitamins and minerals etc., phytonutrients, nitrates of plant origin, and fibers are also considered important for the management of oral health.

Following a proper diet plan, consuming calorie restricted diet and following intermittent type of fasting regimes have also shown promising results in minimizing periodontal inflammation and also result in overall maintenance of oral cavity. This review focuses on how optimized diet along with calorie restriction and intermittent fasting regimes will be helpful in influencing the maintenance of periodontal health and overall oral health.

Keywords: Optimized diet; Calorie restriction; Periodontal health; Periodontal diseases; Intermittent fasting, Oral health

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Introduction

Periodontal disease, or periodontitis is basically the swelling of the periodontal ligament and the tissues surrounding which in most cases is followed by attachment and alveolar bone loss surrounding the teeth. It is one of the major and frequent oral health related diseases affecting around 74.3 Cr individuals around the entire world and is also a major reason for loss of teeth amongst elderly [1,2]. In late 60s periodontitis was thought to be mainly, a plaque-induced disease according to Löe et al [3]. In the due course of assessing its etiology or origin, distinctive speculations were made over few years which gave a better and clearer picture about the disease presence and progression.

Marsh and Devine proposed a "The Ecological Plaque Hypothesis" [4], wherein they stated that the periodontal microbes or bacteria are advocated and aided by the inflammatory response of the host, which not only increases gingival febrility, but along with poor nutrition might contribute to the increase in the amount of secreted gingival exudate. Baumgartner and colleagues [5], conducted research evaluating different individuals during an archaic analysis, revealing noticeable decline of gingivitis and periodontitis, even when oral hygiene was not very well maintained.

Periodontal disease Pathogenesis

Periodontal health is mainly controlled by the maintenance of homeostasis in the immunity and the microbiota which is symbiotic.

Periodontitis occurs most commonly in relation with a community which is dysbiotic and polymicrobial wherein different individual microbes have different and varying roles that help in inflammation which in most cases can is destructive. Keystone pathogens like *P.gingivalis* along with the dysbiotic bacteria like *Prevotella* intermedia and *Aggregeticbacter actinomycetemcomitans* cause a positive feedback loop which might further aid in dysbiosis resulting in inflammation finally resulting in periodontal disease. The risk factors include immunological disorders, poor nutrition, smoking, etc. [6].

Balanced diet

A balanced diet can be defined as a "pattern of food intake that has beneficial effects on health" [7]. Since a few years, experimental results have shown a satisfactory effect of nutrient rich food plans on dental well-being. A variety of range of macro and micro-nutrients might have some influence upon healthy periodontium. The balanced consumption of un-processed compound polysaccharides, plant based amino-acids, Ω-three fatty acids, minerals, and vitamins have a positive impact on periodontal inflammation which is usually followed by disease. Hence, it shows that choosing a correct lifestyle and following proper diet habits must be encouraged in individuals with dental and periodontium related diseases [8].

Table no 1 shows various studies performed with respect to nutrients and various diet components.

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AUTHOR	TYPE OF STUDY	INTERVENTION	OUTCOME
Pushparaja Shetty. [61]	Systematic review	Micronutrients and oral health – an opportunity to prevent oral diseases.	various dietary components along with micro-nutriments & free radical scavengers are vital for optimal oral goodness and important to fasten wound recovery after correct medicament. Micro-nutriment evaluation of suspected separate & correct supplement treatment would help in oral disease control.
M. Perić. [62]	Systematic review	Serum vitamin D levels and chronic periodontitis in adult, Caucasian population—a systematic review	More studies will be needed to be performed in patients with less 25-hydroxy vit D levels randomly, with careful controlling of effect alterations for vit D level and periodontal status, with more doses to get increased 25-hydroxy vitamin D amounts with a correct time period of the treatment to access if long-period influence should be looked for.
Tennert C. [63]	Randomized Control Trial.	An oral health optimized diet reduces the load of potential cariogenic and periodontal bacterial species in the supragingival oral plaque: A randomized controlled pilot study.	A diet with less carbohydrates, high in Ω 3 superfaty acids, high in vit C, D, and high fiber, lessened Streptococcus mitis group, Granulicatella adiacens, Actinomyces spp. & Fusobacterium spp. in supra-gingival plaque.
De Angelis. [12]	A prospective study.	The Effect of an Optimized Diet as an Adjunct to Non-Surgical Periodontal Therapy in Subjects with Periodontitis: A prospective study.	The adopting of food consumption plan showed a reduction in PPD and FMBS after professional mechanical plaque control, than post periodontal treatment alone.

Table 1: Shows various studies performed with respect to nutrients and various diet components.

Importance of diet consistency

An unhealthy or poor diet has been implicated as a risk factor for several chronic diseases that are known to be associated with oral diseases. Dentistry has an important role in the diagnosis of oral diseases correlating with diet. Consistent healthy nutrition intake guidelines are essential to improve health overall. A poor diet was significantly associated with increased levels of oral disease. Dietary advice for the prevention of oral diseases has to be a part of the routine patient education practices [9].

Foods to avoid to maintain a good oral health [10]

- Sticky candies and sweets
- Starchy foods that can get stuck in your mouth.
- Carbonated soft drinks.
- Substances that dry out your mouth

Optimized diet

Optimal diet is the “is the ratio of macro and micronutrient food intake, or the quantity of calories given in by fat, carbohydrate, and protein consumption” [11].

Food consumption relied on compound polysaccharides or simply compound carbohydrates are normally healthy, although the foods high in refined polysaccharides can be related with

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increased tenderness of the oral soft tissue. Exaggerated surges in blood sugar levels (glucose) post food-consumption seems to increase in calorie rich foods, mainly the foods which are refined and processed with high sugars and fats that can be dissolved fast into the blood [12].

The components of optimized diet are mentioned in the figure 1.

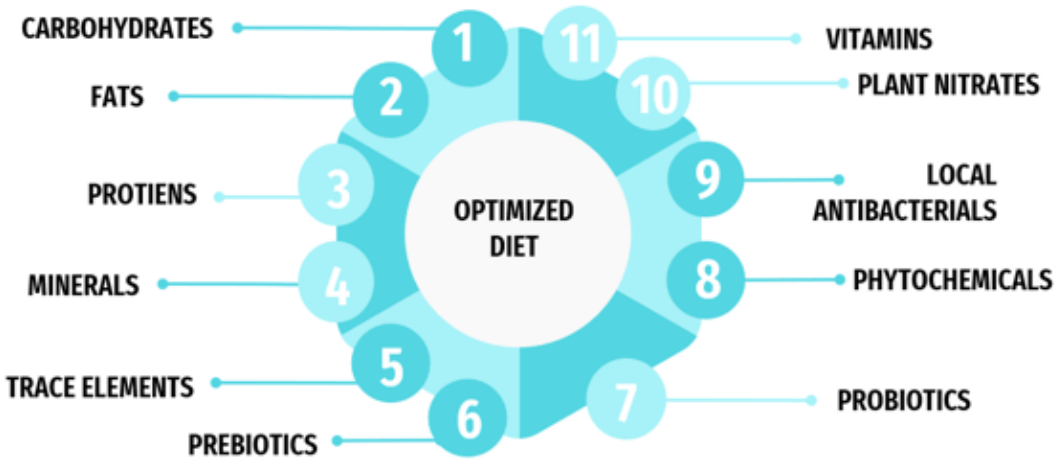

Figure 1: Components included in optimal diet.

CALORIES	2671 kcal
CARBOHYDRATES	267 grams
PROTIENS	90 grams
FATS	30 grams
FIBERS	35 grams
WATER	2.50 -3 litre
ZINC	17 milligrams
IRON	19 grams
VITAMIN C	18 grams
VITAMIN D	600 IU
Kcal = kilocalories. IU = international unit.	

Table 2: Lists the Optimized diet elements and their quantities.

Intermittent fasting

It is a diet regime that needs an individual to abstain from consuming food items or beverages for varying periods of time; for instance, a 16:8 fasting regime (i.e., a sixteen-hours fasting with an eight-hours eating window period), twenty-four -hours fast, the 5:2 diet (i.e., regular food consumption for 5 days a week and then minimising calorie consumption to five hundred-six hundred calories on the next two days), time-restricted food consumption, and fasting every

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other-day. In Alternative-day type of fasting, an individual's food intake is alternated between absence of consumption of any calories for a day and consuming food without any restriction the following day [14].

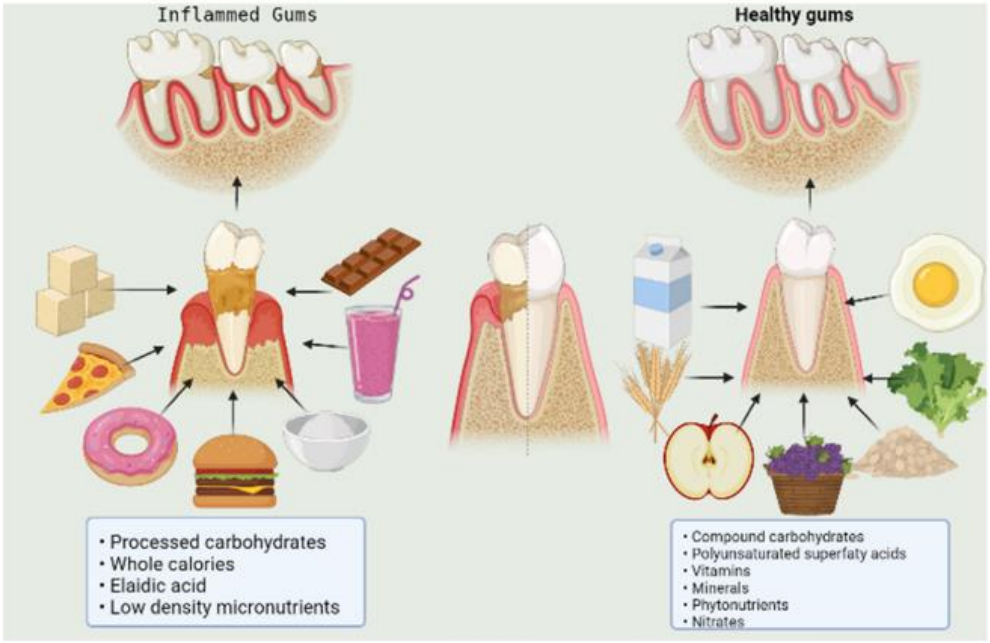

Figure 2: Diet food components and their effect on the gums and periodontium.

The Penmen derived to a conclusion that the existing guidelines for evaluating gingivitis are not relevant if dietary intake does not comprehend processed carbohydrates [15]. Hence, diet is found to have a consequence on the periodontal and gingiva related inflammatory reactions. The diet-related well-being of periodontal tissues can be seen, when carbohydrates are reduced, and an added consumption of polyunsaturated fatty acids, vitamin D, C, free-radical scavenger's and fibre is consumed [16–22]. Also, the initial studies performed on animals give some insight into the localized and systemic effects of restricted intake of calories and intermittent type of fasting on inflammatory mediators that have influence on inflammation of the periodontium and the progression of the disease [23–27].

Role of optimized Diet in Periodontal Health

The increased consumption of polysaccharides helps in dysbacteriosis ad leads to infectious conditions [15]. The minimizing of the diet rich in polysaccharides seems to decrease gingival tenderness [16]. In-vitro researches revealed that increased sugar levels might cause cellular death and stall regeneration of periodontal ligament tissues [15].
Also, an imbalance between Ω-6 and Ω-3 fatty acids promote tenderness. Positively, there is increasing proof that Ω-3 fatty acids paves way to decrease inflammatory reactions [15]. Hence it can be said that the lesser consumption of carbohydrates or polysaccharides, and an increased

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consumption of Ω fatty acids helps in the reduction of the inflammation caused during periodontal diseases.

AUTHOR	TYPE OF STUDY	INTERVENTION	OUTCOME
Grishondra L Branch-Mays [23].	A comparative study.	The effects of a calorie-reduced diet on periodontal inflammation and disease in a non-human primate model.	The clinical results are accordant with the known evidence that restriction of calories has anti-inflammatory effects. Calorie restricted diet resulted in a significantly reduced ligature-induced inflammation of gingiva, BOP, Pocket depth, and CAL.
Mark A Reynolds [24].	A Review.	Effects of caloric restriction on inflammatory periodontal disease.	Male subjects showed higher risk for normal occurrence of periodontal disease than female subjects. Long phases of restricted calorie intake might differentially reduce the production of local inflammatory mediators and risk for inflammatory periodontal disease among male subjects but not female subjects.
Park Ho-Seob [27].	A non-randomized pre-post pilot study.	Change of periodontal inflammatory indicators through a 4-week weight control intervention including caloric restriction and exercise training in young Koreans.	In individuals with normal periodontal health, weight control might help with the reduction of the amounts of MMP-8, MMP-9, and IL-1β in GCF of the obese subjects. More studies including periodontally unhealthy and obese individuals are needed for identification of mechanisms of decrease in inflammation-biomarkers in GCF with the help of weight control.
Lia Kartika Wulansari. [26]	Research article.	Beneficial effects of fasting regimens on periodontal tissues in experimental periodontitis mice model.	The study shows that after ligature removal and subsequent treatment, fasting schedules enhance periodontal regeneration of the tissue. the results are supported by in vitro data wherein cells retrieved from groups of animals received treatment with fasting have greater osteogenic potential compared to that of cells retrieved from groups of animal's sans fasting treatment.

Table 3: showing components in the Optimized diet chart.

Intermittent Fasting and Calorie Restriction

Periods of deliberate abstinence from food and beverages has been practiced since early times by people around the world. Data on ethnohistory and religious texts depict various fasting regimens and methods [28].

Intermittent fasting is of various types and one has to follow a different regimen in each type. Effects of calorie restricted diet and intermittent type of fasting on the periodontium are depicted in the figure no 3.

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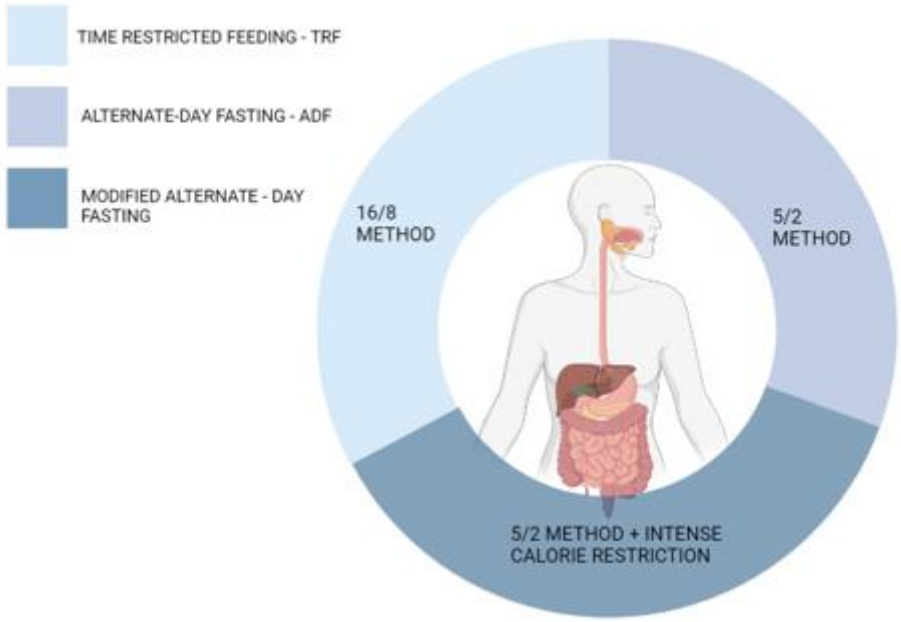

Figure 3: Types of intermittent fasting.

Meal	Menu	Portion
Early morning (7:00 AM)	warm lemon water + linseeds/ benne seeds / mirasol seeds	1 tumbler One tbspn (15 grams)
	After 20 minutes	
	Masala chai/ curcuma milk + badam/kaju/ pista/walnut	70 millilitre / 150milliletre 10 numbers.
Breakfast (9:00am)	Veg flattened rice/ Oatmeal + 1 citrus fruit Or 3-4 Idly + Sambhar+ papaya Or 2 Boiled eggs with two brown bread slices+ apple Or Veg dal Dhaliya	1 cup (100 grams) 1 crock+ 50 grams 1 crock (150-200grams)
Mid-Morning (11-12 pm)	Banana/ avocado shake Or Green smoothies (spinach, pudina, parsley, limon).	1 tumbler (200millilitre) 200 millilitres

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Lunch (2-3pm)	Vegetable mash Dal (toor/channa Rajma/ chole/soya) Leafy greens Other veggies Rice (brown/white) Multigrain chapati (If you don't take rice then take 3 roti) yoghurt/ buttermilk	60grams 30grams 30grams 30grams 30grams 2 number medium size 50grams/250millilitre
Evening (5-6pm)	Masala chai/ muskmelon juice + Sprouts/ roasted groundnut/chickpeas (Add ½ lemon on it)	1 cup/ 200millilitre, 50grams
Dinner (8pm)	Lentil soup/ Chicken / veg broth Mix veg + chapati + yoghurt Roasted fish/ chicken lentil porridge + yoghurt + Cottage cheese Veg + rice/ chapati + yoghurt	1 crock (150 millilitre) 30grams + 2 numbers, 30 grams 100grams 1 crock(150grams) + 50grams 50grams,30grams/1,2roti+30grams
Bedtime (10pm)	curcuma / elaichi milk+ Walnut/ Pista	150 millilitres,5-10 numbers.

Table 4: Showing various studies done with respect to calorie restriction and intermittent fasting.

Type of fasting	Regimen details
Complete alternate-day fasting	This regimen involves fasting on alternative days (avoiding consumption of energy containing foods or drinks) while consuming on the remaining days (foods and beverages consumed in limit).
Modified fasting regimen	This regimen allows for consumption of 20%-25% of energy containing food on scheduled fasting days. This regimen forms the base for the popularly known 5:2 regimen, which includes extreme energy restriction for two non-consecutive days every week and limited food consumption on other five days.
Time-restricted feeding	This regimen allows individuals for consumption of limited energy intake within specific time gaps, which induces fasting periods on a routine basis.

Table 5: Showing Types of fasting and regimens.

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Components inclusive of the optimized diet are

Carbohydrates

Carbohydrates or the polysaccharides alongside fats, are large energy sources. Unlike consumables with low-carbohydrates, high-carbohydrate foods cause a faster rise in blood sugar levels [17,30,31]. A latest study showed, carbohydrate intake and an increased whole caloric consumption caused inflammatory reactions [15]. The latest studies establish that high-polysaccharide containing food consumption might escalate gingival and periodontal disease [6,15,16,32]. In disparity, the food intake which is plentiful in compound or un-processed polysaccharides and fibres is analogous with reduced occurrence of gingivitis and periodontitis [15,22,33]. Due to the noted interrelation of high-glycemic carbs and caries, a latest study group about the confines in-between cariogenicity and periodontally compromised diseases noticed refined carbohydrates as a split probability factor for either of the diseases [21].

Lipids

Lipids provide energy and power and are basis of organizational and assimilated complexes (such as cell membranes and hormonal components) [34]. Serhan and fellow workers found that, the intent of an inflammatory reaction is an active flow of events focused on metabolites of Ω-three superfaty acids, presumed as “specialized pro-resolving mediators” (S.P.M), in lieu of unassertive events based upon the eradication of the inflammatory cytokines [18].

Amino acids

Proteins on the other hand are made-up of amino acids and are found in all cells. in regard with innate inflammatory process, amino acids (proteins) are observed to be relatively unbiased [34]. Animal amino acids are believed to raise insulin-like growth factor one in the body which is detected to have a vital role in causing cancer [35–39]. On the contrary, plant amino acids might seem to lessen the probability of cardiac related diseases, type II diabetes mellitus, and related diseases [40–42]. Within the sphere of periodontology, only a few investigations have been done to assess if proteins in general or specifically animal proteins are related to periodontium associated diseases.

Penmen like Osborn MO [33], Staufenbiel I [43], Zong G [44] in their investigations stated that, vegetarians showed lesser pocket depths, lesser bleeding on probing, and superior oral health maintenance in comparison with meat consuming individuals [43] along with good oral health maintenance. In an analysis of periodontal inflammatory ailments, all the patients consumed a diet abundant in amino acids [45]. Individuals with reduced serum cobalamin levels had a greater likelihood of occurrence of periodontium related lesions [44].

Vitamins

Impact of vitamins and other microelements has been in discussion since long in relation to periodontal related diseases [20]. Vitamin micronutrients can be assorted by their potentiality

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to break down in fats, (vitamins like retinol, phylloquinone, D2, D3 and Tocopherol) or to breakdown in water (like ascorbic acid and B-complexes). Prevalence studies manifested lesser serum levels of vitamin micronutrient C and its lesser consumption in periodontally diseased patients in comparison to patient's sans periodontium related disease.

Vitamins behave in a different way when present in plants (e.g., phytonutrients, enzymes) in comparison with the factitious structure [46,47]. Greater ingestion of vitamin C containing fruits (like Citrus paradisi, lime, bell pepper species, kiwifruit etc.) might decrease gingiva and periodontium related inflammation [15,48], and an intake two grams of unnatural ascorbic acid as a supplement to non-surgical periodontal therapy revealed scarce outcome after four weeks in a placebo-controlled experiment [49]. Krall et al and Laky et al noticed reduced tooth losses in an inactive drug-controlled randomized experimental investigation where patients (of age around 65 years) were supplemented with calciferol [50] and calcium respectively. Groups supplemented with vitamins showed a positive response compared to the placebo-controlled groups [51]. Positive outcomes on periodontium related health were noticed for cobalamins along with alpha-tocopherol and also retinol [13,20,43,52].

Minerals

Evaluative reviews and prevalence studies revealed that magnesium oxide insufficiency corresponds to greater occurrence of periodontium related disease in adults, and that calcium oxide consumption inversely corresponds with periodontal disease in Japanese females of younger age groups [29,53–55]. which means that in different areas or parts of the world, the mineral consumption is different and has certain effect on the oral tissues.

Pre and Probiotics

Supplementation of probiotics as an adjunct to regular professional mechanical plaque removal remarkably decreased gingiva related inflammation [56].
The usage of probiotics with an effectiveness record showed by clinical trials, might show a valuable effects obtainable therapeutic options, chiefly in clinical scenarios in which entrenched notions relied on plaque management cannot be executed with the needed results [57]. Pre-biotics are largely unmetabolized fibers that are made up of compound polysaccharides (like inulin and galacto-oligosaccharides). Slomka et al. found two prebiotics which might be convenient in encouraging the bacteriae, like D- mannac, methyl beta-D-galactopyranoside for oral well-being [58].

Phytochemicals, plant nitrates and local Anti-bacteria

Phytonutrients are chemical elements assimilated by flora or plants with many health profits or benefits. They are inclusive of phytochemicals (like polyphenols, catechins, ligands, anthocyanin, isoflavones etc) and carotenoids and mainly have an anti-inflammatory effect [59]. Clinical trial's by Jockel-Schneider et al [60] revealed an everyday regular consumption of 300 mL of Lactuca sativa (commonly knowns as lettuce) extract (with 200 milligrams of nitrates) remarkably decreased gingiva related inflammation. Apart from the expressed

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systemic-mediated consequences of food intake on periodontal health, there are a lot of antibacterial complexes encountered in eatables.
Diet food components and their effect on the gums and periodontium are depicted and mentioned in the figure no 4.

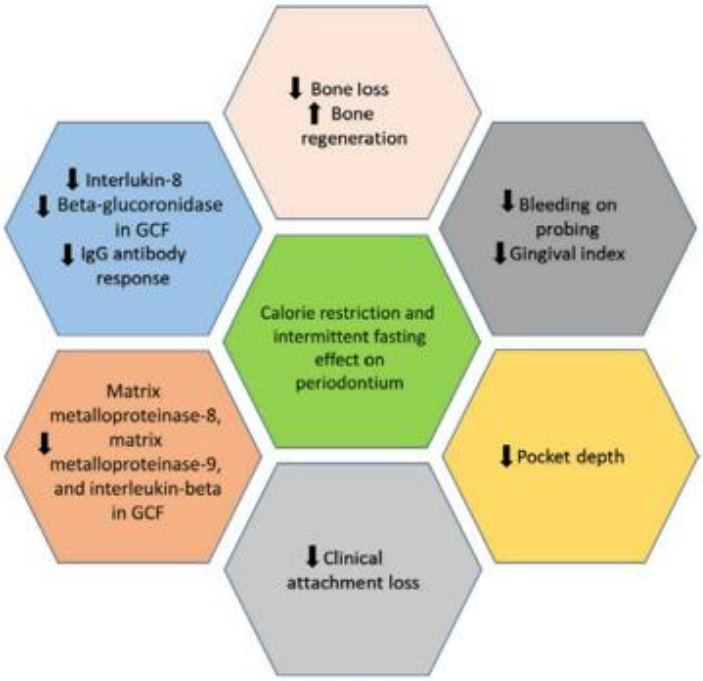

Figure 4: Effects of calorie restricted diet and intermittent type of fasting on the periodontium.

Current and future aspects

One's diet can help in maintaining the health of the periodontium. It can be considered like prevention before the treatment. Various components mentioned in the above literature when optimized accordingly to every individual's need might help in the overall maintenance of the body as well as the oral cavity. The optimization should be done according to the demographics of an individual and the patients should be educated and motivated to follow and keep up with the diet and the general oral hygiene.

In this way we might be able to prevent the periodontal disease to a certain extent and in cases where the disease has already sent in, it can be a commendable adjunct to the dental treatment which would be provided to the patients.

Conclusion

Concluding the conferred literature, an essentially plant grounded low-carb diet, abundant in Ω-3 fatty acids, might be a classic formulation for periodontal, oral and general health. Along with the proper diet, fasting and calorie restriction in the food consumption has shown

promising results in the oral hygiene maintenance. Furthermore, studies and clinical trials with much details and results need to be worked on so, as to know in depth with respect to the consumption of the particular diet components and the practicing of the diet regimens.

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