Review Article

Role of Probiotics in Orthodontics

Kour S, Verma VK, Sachan A, Singh K, Arora A, Kaur G

Abstract: Enamel demineralization leading to white spot lesions is the most common problem faced during or after orthodontic treatment. Various methods have been suggested to prevent enamel demineralization among which fluorides are the most common, but they also have some disadvantages. Now-a days probiotics are proving to be very beneficial for oral health in preventing gingivitis, halitosis and caries. Probiotics are "live microbial food supplements which beneficially affect the host animal by improving its intestinal microbial balance. Probiotic therapy with the concept of using good bacterias to replace the harmful ones emerged as a fascinating field with the increasing incidence of antibiotic resistance. Probiotics have been in practice for several years in general health. Interest has been drawn towards oral health in the recent years. The studies conducted on oral health suggest that probiotics could be a viable option in preventing and treating the enamel demineralization by reducing the levels of pathogenic bacteria i.e streptococcus mutans. This article updates the available data on the potential benefits of probiotics for orthodontic patients.

Keywords: Probiotics; Streptococcus Mutans; White Spot Lesions; Bacteria; Orthodontic.

INTRODUCTION

Despite of the advances in the orthodontic appliances and treatment protocols, enamel demineralization leading to white spot lesions is still a grave concern to orthodontists and patients. The overall prevalence of white spot lesions among orthodontic patients has been reported to be between 4.9% and 84%.[1] A white spot lesion is the precursor of enamel caries. White spot lesions develop as a result of an interrupted process with periods of remineralization and demineralization.[1] Various methods have been suggested to inhibit or reverse enamel demineralization. Fluoride delivery systems,[2] casein phosphopeptide, amorphous calcium phosphate,[1] and enamel surface attenuation with an argon laser[3] have proved to be useful but, they have their own disadvantages.[1]

Probiotics are drawing the attention of many researchers in their role in preventing enamel demineralization. *Probiotics* are "*live microbial food supplements which beneficially affect the host animal by improving its intestinal microbial balance*"[4]. Probiotics have greater adhesion to tissues and inhibit pathogens but do not kill friendly bacteria. However, there are a very few studies in the literature on the effect of probiotics in orthodontic patients, since their use in our specialty is still in an infantile stage.[5]

Probiotic therapy is a new concept gradually emerging in the today's antibiotic dominated field and is being used for recurrent diseases. It relies on the concept of using harmless or good bacteria to suppress or eradicate pathogenic or bad bacterias causing harmful diseases. Probiotics as one of the bacteriotherapeutic agents have been widely associated with gut health and most clinical interest has been focused on their use for prevention or treatment of Gastro-intestinal infections and diseases. As the resistance to antibiotics is emerging these days, it is wise to consider the unique concept of probiotic therapy in oral health.

Researchers are now investigating the use of probiotics for preventing enamel demineralization leading to white spot lesions in patients undergoing orthodontic therapy. Although only a few studies have been conducted so far, the results of these studies have identified the positive role of probiotics in preventing and treating oral infections like dental caries, periodontal diseases and halitosis. This article reviews about probiotics in terms of its application in orthodontics.

EVOLUTION:

This concept dates back to the beginning of 20th century when the Russian Nobel prize winner Eli Metchnikoff came up with the idea of modifying gut flora to replace harmful microbes by other microbes. Metchinkoff[6] observed that certain rural populations in Europe (Bulgaria) and the Russian steppes that mainly depend on milk fermented by lactobacilli for their sustenance had comparatively longer lives.

Based on these facts Metchinkoff proposed that consumption of fermented milk 'sown' the intestine with harmless lactobacilli, decreased intestinal pH, thereby suppressing the growth of pathogenic bacteria. The longevity of this theory was doubted and disputed by many at that stage. The term Probiotics was first used by Lilly and Stillwell[7] in 1965. In 2001, FAO/WHO defined Probiotics as "*live microorganisms which when administered in adequate amounts confer a health benefit on the host*."

POTENTIAL MECHANISMS OF PROBIOTIC EFFECTS IN THE ORAL CAVITY

The most commonly used probiotic bacterial strains belong to the genera *Lactobacillus* and *Bifidobacterium.*[8] These bacterial genera are regarded as a part of the normal human microbiota. In the oral cavity, lactobacilli usually comprise lesser than 1% of the total cultivable microbiota, but no species specific to the oral cavity has been found. In contrast, some species are found in both oral and fecal samples.[9,10] Species commonly isolated from saliva samples include *L. paracasei, L. plantarum, L. rhamnosus,* and *L. salivarius.*[9]

Culture-based studies suggest that bifidobacteria are among the first anaerobes in the oral cavity.[10] Indeed, both lactobacilli and bifidobacteria can be found in breast milk, suggesting early exposure of the oral cavity to these bacteria.[11,12] Bifidobacterial species isolated from oral samples include *B. bifidum, B. dentium,* and *B. longum.*[10,14,15] The list of probiotic or good bacterias found in oral cavity are given in table 1. The general mechanisms of probiotics can be divided into three main categories: normalization of the intestinal microbiota, modulation of the immune response, and metabolic effects.[16] Possible ways that probiotics might affect oral health are summarized in Figure 1.

Thus for oral colonization by probiotic bacteria is often been considered essential for them to exert oral effects; however, the possibility of systemic effects cannot be excluded, although the total sIgA levels in saliva seem unaffected by probiotic use.[17,18] Interestingly, maternal use of some probiotic strains seems to influence the composition of breast milk.[19] Just as there are bacterial species associated with oral diseases, there are also species that seem to be associated with oral health[19,20,21] however, it is questionable whether bacteria administered in food could influence relatively stable oral microbiota, in particular in adults

Table 1: Beneficial bacterias in Oral microbiota

1.	Lactobacillus acidophilus
2.	Lactobacillus fermentum
3.	lactobacillus plantarum
4.	Lactobacillus rhamnosus
5.	Lactobacillus salivarius

MECHANISM OF ACTION OF PROBIOTICS

Different mechanisms of action of probiotics have been proposed like [23,24,25,26]

a. Competitive blocking of the adhesion sites at epithelial surfaces.

b. Secretion of various antimicrobial substances such as organic acids, H2O2, Bacteriocin.

c. Immune modulation - modifying the surrounding environment by modulating the pH and/or the oxidation–reduction potential, which may compromise the ability of pathogens to become established.

d. Stimulation of immunoglobulin A production.

e. Down regulation of inflammatory response

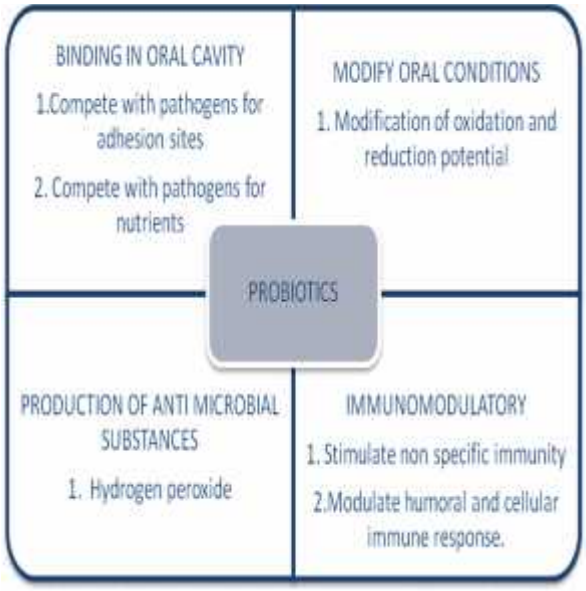

Figure 1: Potential mechanisms by which probiotic bacteria could affect oral health

Probiotics and White Spot Lesions in orthodontic treatment

White spot lesions are caused by *streptococcus mutans* and they are the common scars found during and after orthodontic treatment. The health promoting bacteria can address the imbalance in the oral biofilm by competitively inhibiting the pathogens and shifting the oral mileau to a higher pH thereby, reversing the demineralization.

Fixed orthodontic appliances are considered to jeoparadize dental health due to accumulation of micro-organisms that may cause enamel demineralization, clinically visible as white spot lesions. Furthermore, the complex design of orthodontic bands and brackets may create an ecological environment that facilitates the establishment and growth of cariogenic streptococci mutans which causes gum inflammation and dental caries.

Hence it is important to have good dental hygiene to prevent/minimize the inflammation in the gum and dental caries during the orthodontic treatment. Studies have documented that the administration of probiotics help to reduce the level of S. mutans and the risk of dental caries and also gum inflammation.

DISCUSSION

Probiotic therapy has opened new vistas in the field dominated by antibiotics. Providing healthy bacteria to combat the pathogenic organisms is a valuable and viable option in problems arising due to antibiotic resistance. This concept throws new light on the connections between diet and health. Probiotics initially used in gasteroenterology for promoting the gut health, has slowly found way in the oral cavity, the entrance of the GI tract. The benefits of probiotics in orthodontic patients have been under research recently.

Several studies have also proven its efficiency in combating the white spot lesions by reducing streptococcus mutans levels. Further research is needed before it can be used as regular diet supplementation of these beneficial strains as a prophylactic measure. However, the safety of probiotics needs to be weighed before its administration. The probiotic strains should not be pathogenic and should not transfer the antibiotic resistance genes. With the enormous supplementation of probiotics in different food items, it's quite logical to think of the development of bacteremia. But it is a rare entity.

Bacteremia usually develops in patients with severe debilitating diseases where the immune system is weak. Further the incidence of bacteremia is unsubstantiated in literature.[33] Nevertheless, careful monitoring is needed with this regard in the future. Genetically modified microbial strains[34] are expected to add a new dimension to the concept of bacteriotherapy in the future. The modified strains are expected to reduce the pathogenicity of the potential pathogenic organisms and enhance the beneficial characters of a good strain. Further newer advancements in the field of probiotics can be expected in the future.

Table 2: Shows the studies done on effects of probiotics on oral pathogens.

Studies conducted by	Aim	Conclusion
Caqlar E (2008)[27]	To examine whether or not short-term consumption of ice-cream containing bifido-bacteria can affect the salivary levels of mutans streptococci and lactobacilli in young adults	The Daily consumption of ice-cream containing probiotic bifido-bacteria may reduce the salivary levels of mutans streptococci in young adults
CILDR SK (2009)[5]	To examine whether short-term consumption of fruit yogurt containing probiotic bifido-bacteria would affect the levels of salivary mutans streptococci and lactobacilli in patients with fixed orthodontic appliance	Short-term daily consumption of fruit yogurt containing bifido-bacterium animal is subsp. lactis DN-173010 may reduce the levels of mutans streptococci in saliva during orthodontic treatment with fixed appliances.
Zhu y, Xiao l, Shen D , Hao Y (2010)[28]	To find the relation of probiotics in bio-yogurt and periodontal pathogens in vitro.	Bio-yogurt and the probiotics that it contains are capable of inhibiting specific periodontal pathogens but have no effect on the periodontal protective bacteria.
Ferranzo GF (2011)[29]	To evaluate in vivo whether short-term consumption of commercial yogurt modifies the levels of salivary mutans streptococci and lactobacilli in young subjects	A statistically significant reduction in mutans streptococci counts was observed in the test group compared with the control group. No effects on the levels of lactobacilli were noted. Daily consumption of yogurt for 2 weeks may decrease the salivary levels of mutans streptococci.
Jubin Easo Jose, Sridevi Padmanabhan, Arun B.Chittaranjan (2014)[30]	Systemic consumption of probiotic curd and use of probiotic toothpaste to reduce streptococcus mutans in plaque around orthodontic brackets	The consumption of probiotic curd and use of probiotic toothpaste caused a significant reduction in S.mutans levels in the plaque around brackets in orthodontic patients. Although probiotic toothpaste was more effective than systemic consumption , this was not statistically significant.
Devasya Ashwin et al, (2015)[31]	To evaluate the caries risk based on the salivary levels of *streptococcus mutans* in children of 6-12 years of age group before and after consuming probiotic ice-cream containing *Bifidobacterium lactis* Bb-12 and *Lactobacillus acidophilus* La-5.	Probiotic ice-cream containing *Bifidobacterium lactis* Bb-12 and *Lactobacillus acidophilus* La-5 can cause reduction in caries causative organism. The dosage of the probiotic organisms for the long term or synergetic effect on the oral health are still needed to be explored.
Priya Nimish Deo, Revati Deshmukh (2015)[32]	To evaluate the effect of probiotics on the salivary levels of *Streptococcus mutan*	Bacterio-therapy, which is a novel concept, is a non-invasive method for combating infection and caries

CONCLUSION: Probiotics in orthodontics has emerged as an area of clinical interest. This article reviews the role of probiotics in orthodontics and their implementation in the

future as a therapeutic and prophylactic agent. More research to unravel the mechanisms of possible probiotic action is needed; if probiotics are to provide a new scientifically proven means of preventing or treating oral diseases. Several health-promoting effects of probiotic bacteria are well documented,[2,3] and there is no reason to restrict the use of probiotic products because their effects on oral health are not yet well understood; however, their recommendation for dental health purposes is still in an infantile stage and has to be still justified.

Author affiliations: 1. Dr. Simran Kour, PG student, 2. Dr. Vinay Kumar Verma, MDS, Professor & Head, 3. Dr. Avesh Sachan, MDS, Reader, 4. Dr. Karuna Singh, MDS, Senior Lecturer, 5. Dr. Ayush Arora, MDS, Senior Lecturer, 6. Dr. Guneet Kaur, PG Student, Dept. of Orthodontics and Dentofacial Orthopaedics, Rama Dental College of science and research center , Kanpur, Uttar Pradesh, India.

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Corresponding Author:
Dr. Simran Kour,
PG student
Department of Orthodontics and Dentofacial Orthopaedics,
Rama Dental College of science and research centre, Kanpur, Uttar Pradesh, India.
E-mail: dr.simrankour@gmail.com

How to cite this article: Kour S, Verma VK, Sachan A, Singh K, Arora A, Kaur G. Role of Probiotics in Orthodontics. Rama Univ J Dent Sci 2015 Sept.;2(3):26-31.

Sources of support: Nil
Conflict of Interest: None declared