Research & Reviews: Journal of Dental Sciences

e-ISSN: 2320-7949
p-ISSN: 2322-0090

# Nutrition and Orthodontics-Interdependence and Interrelationship

**Navneet Singh[1*], Tulika Tripathi[1], Priyank Rai[1], Prateek Gupta[1]**

[1]Department of Orthodontics, Maulana Azad Institute of Dental Sciences, New Delhi, India

## Review Article

Received: 21/06/2017
Accepted: 28/07/2017
Published: 03/08/2017

***For Correspondence**

Navneet Singh, Senior Research Associate, Department of Orthodontics, Maulana Azad Institute of Dental Sciences, M.A.M.C Complex, BZ Marg, New Delhi-110002, India,
Tel: +91-9582010450.

**E-mail:** dr.navneetgujjar@gmail.com

**Keywords:** Orthodontics, Nutrition, Health

## ABSTRACT

Orthodontic treatment involves the use of attachments and force element that can negatively affect the dietary intake, compromising the nutrition of the patient. On the other hand, for effective orthodontic treatment, a balanced diet is required. Thus it becomes a vicious cycle, which should be taken into consideration by both the patient and the orthodontist. This paper presents the relationship between nutrition and orthodontic treatment.

## INTRODUCTION

Nutrition is "The science of food, the nutrients and other substances therein, their action, interaction and balance in relation to health and diseases and the processes by which the organism ingest, digest, absorbs, transports, utilizes and excretes food substances" [1]. Intake of requisite nutrition decides the proper growth and development of the individual. During the formative stages of tissues and organs, any nutrient depravity results in severe and permanent deformation. Nutrition also plays an important role in the adjustment of timing of sexual development, delaying menarche in malnutrition and preponing it in obesity [2,3]. The importance of nutrition has been emphasized by Hippocrates, "There are many other ills different from those of repletion, but no less dreadful, arising from deficiency of diet" [4]. The orthodontic treatment ranges from dealing with growth and development of craniofacial complex to the movement of teeth through the medium of surrounding periodontal tissues. Thus, orthodontic treatment and diet have a strong influence on each other. This is because diet determines periodontal status, oral flora, healing potential, immune response and growth of the individual while orthodontic treatment affects the intake, quality and consistency of food [5,6]. Orthodontic treatment generates physical, physiologic and psychological stresses, which levy additional nutritional requirements already hiked by the stresses, activities and growth during adolescence [7]. The nutrition with an indispensable role in orthodontic treatment has been neglected as is evident by scarcity of existing literature. Thus, this paper highlights the significance of nutrition in orthodontics.

### Malocclusion, Malformation and Malnutrition

Guilford was among early pioneers to propose dietary deficiencies as also the etiology of dentofacial deformities [8]. Nutritional deficiencies can significantly alter the functioning of endocrine glands of the body which has an effect not only on the growth and development of whole body but also the dentition [9]. Animals fed on diet lacking in folic acid, riboflavin and zinc have increased chances of cleft lip and palate in the offsprings [10]. There is an association between malnutrition and impaired growth and the development of facial bones [11-13]. Malnutrition may result in reduction of skull base length, jaw height, [14] maxillomandibular width and lower facial height [12]. Altered growth of craniofacial bones lead to insufficient space for teeth to erupt resulting in crowding, impactions and ectopic eruptions [15-17]. Animal studies have further revealed the role of proteins in the growth of jaws and teeth with significant effect on shape and size of the mandible [16-18]. Thus malnutrition produces relative and absolute changes in the spatial arrangements of the teeth in the jaws. Cortical thinning, enlargement of medullary spaces and reduced osteoblastic and osteoclastic activity are other unfavorable skeletal effects that has been observed [19].

e-ISSN: 2320-7949
p-ISSN: 2322-0090

The mode of acquiring nutrition also has a bearing on the development of orofacial structures. Breast-feeding is crucial for development and synchronicity of muscles of the orofacial region which later aids in overall maturation of various vital functions and growth of dentofacial structures [20]. Narrow arches resulting from underdeveloped muscles and supporting structures was observed in subjects on soft diet as compared to hard diet [21]. A positive correlation was seen between non-consumption of coarse and fibrous foods and increased incidence of class II malocclusion [22]. The vitamins and minerals constitute an important component of diet and are actively involved in normal growth and development. Vitamin A deficiency associated with protein deficiency result in inadequate bone growth concomitant with malocclusion of teeth while Vitamin A excess and Vitamin D deficiency causes skull softening following decreased calcium deposition and also increase the susceptibility for cleft lip and palate [23,24]. Vitamin D helps in metabolism of calcium and phosphorous which are required for skeletal and dental growth [9]. Vitamin D deficiency causes rickets and maxillary dysplasia, Closure of facial sutures is hampered leading to open bite, transverse hypodimension and misshapen palate [25,26]. The individual with magnesium deficiency may lead to habit of bruxism [27].

**Effect of Orthodontic Treatment on Nutrition**

Orthodontists instruct patients to avoid sticky, gummy, chewy or very hard food to circumvent appliance breakage and bracket debonding [28]. Preferential intake of soft diet during orthodontic treatment result in dietary changes that lead to reduced fiber and carbohydrate intake and increase in intake of fats. Strause and Saltzmann reported reduction in copper and manganese during orthodontic treatment [29]. It was assigned to the non-consumption of nuts, whole grains and reduced ingestion of fruits and vegetables. Copper is required for hemoglobin and red blood cell production; component of enzymes of redox systems and collagen crosslinking; and normal pigmentation [29-31]. Manganese plays a crucial role in bone remodelling and glucose metabolism [30].

**Effect of Nutrition on Orthodontic Treatment**

The orthodontic therapy is highly dependent on the good health of oral tissues. Frequent ulcerations, inflamed oral tissues and compromised periodontal tissues negatively hamper the orthodontic therapy. Hence, the quality of diet directly influences the efficacy of orthodontic therapy.

***Demineralization***

The unregulated sugar consumption, inadequate oral hygiene causes decalcification of teeth under the bands and brackets. Featherstone and Glatz reported measurable demineralization, gingival to bands and brackets in a period of 4 weeks [32]. The Bracket configuration, presence of wires, elastics, springs and other attachments interfere with patient's ability to keep some portion of teeth and brackets clean, which may lead to demineralization. The clinical observation suggests junction between bonding resin and enamel, especially gingival to bracket base to be the most common site of demineralization [33]. This can be seen as white spot lesions.

***Dental decay***

The sticky foods and improper oral hygiene raise the vulnerability of the dentition towards dental caries. Many foods carry constituents called buffers like calcium from milk and protein from meat, which can neutralize or absorb acids. Topical Fluoride application inhibits dental caries by conversion of hydroxylapatite crystals of enamel into less acid soluble fluorapatite. But excess fluoride should be avoided to prevent dental fluorosis characterized by brownish and corroded appearance of teeth.

***Root resorption***

The problem of root resorption is an important challenge in orthodontic therapy which can be influenced by the type of diet. According to Marshall et al deficient diets cause greater resorption as compared to adequate diets as seen through animal studies [34]. Beck study on dogs revealed more susceptibility to resorption following calcium and vitamin deficiencies [35]. Vitamin D maintains calcium phosphorous balance and its deficiency leads to cemental resorption [36,37]. Engstrom et al. inferred that increase in alveolar bone turnover is the cause of root resorption in moderate hypocalcaemia [38].

***Effect on tooth movement and stability of orthodontic correction***

The orthodontic forces induce biologic responses, which involves complex coupling of osteoclastic and osteoblastic activities. Tooth movement requires simultaneous synchronous functioning of collagen metabolism. Collagen metabolism depends on adequate supply of Vitamin C for production of mature collagen. The lack of Vitamin C affects periodontal ligament and creates enlarged endosteal and periosteal spaces with osteoclastic activity thus affecting tooth movement and retention following orthodontic treatment [39]. It has also been observed in vitamin C deficient individuals that orthodontically corrected teeth were unstable and relapse is faster as compared to individuals with no vitamin C deficiency [40].

***Effect on bone health***

For modest bone health, Calcium phosphorous ratio should be greater than 1. In adolescent diet and with orthodontic

e-ISSN: 2320-7949
p-ISSN: 2322-0090

treatment, this ratio was found to be less than 1 due to the consumption of phosphorous rich soft drinks and fast foods with avoidance of calcium rich dairy products [41]. Mc Canlies noticed large resorption lacunae and increased osteoclastic activity secondary to vitamin C deficiency [40]. This jeopardizes the bone remodelling, slowing orthodontic tooth movement.

***Periodontal problems***

Nutritional deficiencies have no direct relationship with the development of gingivitis or periodontal pocket but can exacerbate the detrimental effects of local irritants on the periodontium [42]. Soft diet aids plaque and calculus formation while hard and fibrous food imparts surface cleansing action preventing plaque formation and stimulatory effect increase the alveolar bone density [43].

Vitamins are vital to maintenance of periodontal health as vitamin A deficiency causes keratinizing metaplasia of the epithelium, thus, increasing vulnerability to infections [44]. Vitamin B deficiency is established as a cause of gingivitis, glossitis, angular chelitis and oral mucositis [45]. Folic acid deficiency is characterized by non-inflammatory necrosis of gingiva, periodontal ligament and alveolar bone [46]. Vitamin C deficiency causes scurvy by disturbance in collagen metabolism, thus, affecting tissue regeneration and repair potential [36].

**Orthodontic Treatment and Balanced Diet**

During orthodontic treatment, nutritional history should be accounted and patients' diet should be adjusted to include all necessary elements keeping in mind the habits, convenience, likes and dislikes of the patients. Dairy products (milk, cheese, ice cream) should be prescribed during orthodontic treatment as they are soft and assist bone remodelling during tooth movement [6].

Understanding the importance of nutrition, American dental association has delineated in 1987 guidelines "the graduate must be competent to provide dietary counselling and nutritional education relevant to oral health" [47]. Learning of nutrition and diet is also incorporated in dental education in Indian institutions. During orthodontic treatment, patients are advised to follow stop, halt and go pattern of food consumption.

**Stop (Never Eat)**

Chewing gum, caramel, toffee and all sticky candy, ice cubes, popcorns kernels, raw apple or carrot, corn on corb, hard pretzels, pizza crust, chocolate chips, nuts, carbonated drinks.

**Halt (Think Before Eat)**

Chips, chicken wings, raw vegetables, hard fruits when cut into small pieces, loose corns, crusty bread, high sugar foods.

**Go (Can Eat)**

Potato chips, steamed vegetables, french fries, yoghurt, pudding, jelly, soup, cereal in milk, cheese, eggs, milk shakes, ice cream without nuts.

## CONCLUSION

There is a two way relationship between nutrition and orthodontic treatment wherein the quality of nutrition affects the pace of orthodontic treatment and the rendering of orthodontic treatment affects the nutritional intake. A well balanced diet provides all the essential elements to keep the oral tissues healthy and aid in bone remodelling thus enhancing orthodontic therapy. On the other hand, ensuring maximum comfort of the patient while administering orthodontic treatment, minimally affects the dietary pattern and thus, nutrition of the patient.

## REFERENCES

1. Council on foods and nutrition. Nutrition teaching in medical schools. J Am Med Assoc. 1963;183:995-997.
2. Epstein LH, et al. Childhood obesity. Pediatr Clin North Am. 1985;32:363-379.
3. Forbes GB. Influence of nutrition. In: Forbes GB (ed). Human body composition: Growth, aging, nutrition and activity. Springer-Verlag, New York. 1987.
4. Simmonds N. Nutritional corrections as an aid in overcoming growth defects in the oral structures. Am J Orthod Oral Surg. 1939;25:115-123.
5. Rogol AD, et al. Growth and pubertal development in children and adolescents: Effects of diet and physical activity. Am J Clin Nutr. 2000;72:521S-528S.
6. Sharma R, et al. Nutritional guidelines for orthodontic patients. Internet J Nutr Wellness. 2009;10:1-4.
7. Hickory W and Nanda R. Nutritional considerations in orthodontics. Dent Clin North Am. 1981;25:195-201.
8. Cohen MB. The relation of allergic encroachment on the constitution to orthodontic deformity. Angle Orthod. 1939;9:30-34.

e-ISSN: 2320-7949
p-ISSN: 2322-0090

9. Gupta S, et al. Delayed teeth eruption a mirror to systemic deficiency of vitamin D. Indian J Dent Sci. 2015;7:56-59.
10. Munger RG. Maternal nutrition and oral clefts. In: Wyszynski DF (ed). Cleft lip and palate: from origin to treatment. Oxford University Press, New York; 2002.
11. Caceda J. Nutritional status and dental and skeletal development in peruvian children. Proceedings of the 74th General Session of the International Association for Dental Research, San Francisco, CA, USA; 1996.
12. Songvasin C. Early mal-nutrition and craniofacial growth. Proceedings of the 72th General Session of the International Association for Dental Research, Seattle, WA, USA; 1994.
13. Caceda J. Effect of nutritional status on dental age. Proceedings of the 72th General Session of the International Association for Dental Research, Seattle, WA, USA; 1994.
14. Weissman S. Craniofacial growth and development in nutritionally compromised peruvian children. Proceedings of the 71th General Session of the International Association for Dental Research, Chicago, IL, USA; 1993.
15. World Health Organization. Oral Health Surveys: Basic Methods. 4th edn. ORH/EPID, Geneva, Switzerland; 1997.
16. Luke DA, et al. Metrical analysis of growth changes in the jaws and teeth of normal, protein deficient and calorie deficient pigs. J Anat. 1979;129:449-457.
17. Tonge CH and McCance RA. Normal development of the jaws and teeth in pigs, and the delay and malocclusion produced by calorie deficiencies. J Anat. 1973;115:1-22.
18. DiOrio LP, et al. The separate effects of protein and calorie malnutrition on the development and growth of rat bones and teeth. J Nutr. 1973;103:856-865.
19. Bourrin S, et al. Dietary protein deficiency induces osteoporosis in aged male rats. J Bone Miner Res. 2000;15:1555-1563.
20. Festila D, et al. Suckling and non-nutritive sucking habit: what should we know? Clujul Med. 2014;87:11-14.
21. Beecher RM and Corrucini RS. Effects of dietary consistency on craniofacial and occlusal development in the rat. Angle Orthod. 1981;51:61-69.
22. Singh A and Chawla T. Class II div 1 in patients with less fibrous foods. Angle Orthod. 1994;12:223-229.
23. Fox GN and Maier MK. Neonatal craniotabes. Am Fam Physician. 1984;30:149-151.
24. Ackermans MM, et al. Vitamin A and clefting: Putative biological mechanisms. Nutr Rev. 2011;69:613-624.
25. Preece MA, et al. Vitamin D deficiency among Asian immigrants to Britain. Lancet. 1973;301:907-910.
26. Zambrano M, et al. Oral and dental manifestation of vitamin D dependent rickets type I: Report of a pediatric case. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2003;95:705-709.
27. Basic V and Mehulic K. Bruxism: An unsolved problem in dental medicine. Acta Stomat Croat. 2004;38:93-96.
28. Ehrlich A. Nutrition and dental health. 2nd edn. Delmar Publishers, NY; 1994.
29. Strause L and Saltman P. Role of manganese in bone metabolism. In: Kies C, editor. Nutritional bioavailability of manganese. American Chemical Society, Washington (DC); 1987.
30. Townsend CE. Nutrition and diet therapy. Delmar publishers Inc, Albany (NY); 1989.
31. Food and agriculture organizations of the United Nations. Hand book of human nutritional requirements. Food and agriculture organization of the United Nations, Rome; 1974.
32. Glatz EGM and Featherstone JDB. Demineralization related to orthodontic bands and brackets-a clinical study. Am J Orthod. 1985;87:87.
33. Mizrahi E. Enamel demineralization following orthodontic treatment. Am J Orthod. 1982;82:62-67.
34. Marshall JA. Root resorption of permanent teeth-A study of bone and tooth changes incident to experimental tooth movement. J Am Dent Assoc. 1930;17:1121.
35. Beck BW and Harris EF. Apical root resorption in orthodontically treated subjects: Analysis of edgewise and light wire mechanics. Am J Orthod Dentofac Orthop. 1994;105:350-361.
36. Pavithra RS, et al. Vitamin deficiency and periodontal disease- A tie-in relationship. Sch J App Med Sci. 2017;5:74-81.
37. Oliver WM. The effect of deficiencies of calcium, vitamin D or calcium and vitamin D and of variations in the source of dietary protein on the supporting tissues of the rat molar. J Periodontal Res. 1969;4:56-69.
38. Engstrom C, et al. Effect of orthodontic force on periodontal tissue metabolism. A histologic and biochemical study in normal and hypocalcemic young rats. Am J Orthod Dentofacial Orthop. 1988;93:486-495.

e-ISSN: 2320-7949
p-ISSN: 2322-0090

39. Boyera N, et al. Effect of vitamin C and its derivatives on collagen synthesis and cross-linking by normal human fibroblasts. Int J Cosmet Sci. 1998;20:151-158.

40. McCanlies JM, et al. Effect of vitamin C on the mobility and stability of guinea pig incisors under the influence of orthodontic force. Angle Orthod. 1961;31:257-263.

41. Riordan DJ. Effects of orthodontic treatment on nutrient intake. Am J Orthod Dentofacial Orthop. 1997;111:554-561.

42. Moynihan P and Peterson PE. Diet, nutrition and the prevention of dental diseases. Public Health Nutr. 2004;7:201-226.

43. Stefano Petti, et al. The effect of milk and sucrose consumption on caries in 6-to-11-year old Italian school children. Eur J Epidemiol. 1997;13:659-664.

44. Boyle PE. Effects of vitamin A deficiency on periodontal tissues. Am J Orthod Oral Surg. 1947;33:744-748.

45. Red-blue lesions. Oral pathology: clinical pathologic correlations. Saunders, Philadelphia; 2007.

46. No authors listed. Folic acid monograph. Altern Med Rev. 2005;10:222-229.

47. American Dental Association. Procedures for evaluation requirements and guidelines for dental education programs. American Dental Association, Chicago. 1987.