



## Dietary regimen in Orthodontics

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Submitted: 20-05-2022

Accepted: 30-05-2022

### ABSTRACT

The first wealth of human is health. The field of orthodontics is concerned to achieve pleasant aesthetics with optimum functional efficiency. Nutrition and balance diet is the most important factor for a successful orthodontic treatment. The force elements and the various attachments involved in the treatment keep the patients deprived from the essential nutrients which will help us to achieve good results. This is a two-way relationship between the nutrition and the orthodontic treatment which aids in maintaining in good oral health of tissues and bone remodelling. The aim of this review article is to highlight the effects of nutrition and hormones in orthodontic treatment outcome to improve the quality of life of patients.

### I. INTRODUCTION

Nutrition is the biochemical and physiological process in which an organism uses food to support its life. It includes ingestion, absorption, assimilation, biosynthesis, catabolism, and excretion. [1] Intake of requisite nutrition decides the proper growth and development of the individual. During the formative stages of tissues and organs, any nutrient deprivation results in severe and permanent deformation. Nutrition plays a vital role in the adjustment of timing of sexual development, delaying menarche in malnutrition and preponing it in obesity [2,3]. Good nutrition fosters health in all the areas of our existence. In today's era of competition in every field, people are more concerned about the healthy diet and a healthy lifestyle. In fact, the governments of various countries have been working to formalize national nutrition monitoring systems, and there are new labelling laws for foods regarding fat and salt content. [4]

Guilford was among early pioneers to propose dietary deficiencies as the aetiology of dentofacial deformities [5]. Orthodontics and nutrition together define facial balance and dental arch proportions to accommodate all teeth. A well-proportioned 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. Orthodontic treatment

generates physical, physiologic, and psychological stresses, which demands additional nutritional requirements already hiked by the stresses, activities, and growth during the pubertal period. [6] Orthodontic treatment creates physical, physiologic, and emotional stresses which increase the nutrient mobilization and utilization thus raising the nutritional requirements of the person. A fixed orthodontic treatment mostly lasts for around 1½ to 3 yrs., during which certain dietary restrictions and modifications are advised. Typically, the Orthodontist often advises their patients to eat soft food during treatment to avoid pressure sensitivity and frequent breakages, but very few give clear-cut instructions or provide diet charts. Thus, patients switch over to convenient easy-to-eat food, without any special attention to the nutrient values of the consumed food. The literature suggests that orthodontic patients' nutritional status can affect the reaction of the tissues to orthodontic forces. This article will review the relationship of nutrition and orthodontic treatment; it also can reveal the role of the Orthodontist in facilitating good nutrition for good oral health.

Nutrients can be broadly classified as

- 1) Carbohydrates
- 2) Proteins
- 3) Lipids
- 4) Vitamins
- 5) Minerals
- 6) Water

### Effect of nutrition on dentofacial structure

#### 1) Carbohydrates

Cereals (Carbohydrates): - Carbohydrates are the sugar molecules which provide energy to the body. Recently, the consumption of refined food has increased, which has led to an increased prevalence of malocclusions and a decrease in jaw size. Other features include a lower level of eruption, narrow maxillary arches, short mandibles and thin condyles, less tonicity of temporal and masseter muscles, and the linear dimension of the skull is also reduced. Fibers are long strands of simple sugar which are important for digestion & form roughage for bowel movements. Thus, insufficient intake of coarse diet leads to a deficient stimulus to muscles, and thus there is occurrence of narrow maxillary arches. [7] This altered growth of



craniofacial bones leads to insufficient space for teeth eruption resulting in crowding, impactions, and ectopic eruptions.

Carbohydrate group should ideally provide  $\frac{1}{4}$ <sup>th</sup> of our total energy requirements. A typical Indian diet consume cereals in the form of chapattis, rice, and bread. They are an easy food groups for braces wearers because most grain products are very soft and easily chewed. In cases of discomfort dunking/mashing chapattis in curries and dals ensure that you do not miss two most vital components of a balanced diet – carbohydrates and proteins.

## 2) Proteins

Proteins: - Malnutrition may result in reduction of skull base length, jaw height, maxilla and mandibular width and lower facial height. There exists an important relationship between diet and development which can be seen during the nutrition of the foetus; placenta is the provider of the essential nutrient substrates and foetal tissue synthesizes its own proteins and nucleic acids. Therefore, interferences with substrate availability results in decreased protein metabolic activity. [8] According to Miller, “Critical Periods” exist during the development of organ and if stress is imposed in such period it can result in irreversible changes. [9]

## 3) Lipids

Disturbances in the lipid metabolism are not quite common but they do occur as:

-Gauchers disease

-Neimann Pick disease

NEELEY & GONZALES observed in their study that

- There is a risk associated: Diabetes Type II, congestive heart failure, hypertension, coronary artery disease & arrhythmias, obstructive sleep apnea. These are not common in adolescent but with increasing inflow of adult patients’ knowledge is must. In adults for sleep apnea splints for anterior positioning of mandible are given.
- The predominant hormone of the fat regulation is leptin, which is produced by adipocytes causing feedback mechanisms. (10)
- Yagasaki et al [11] conducted experiment to evaluate the role of leptin in craniofacial growth development. In the mice the leptin deficiency caused decrease in Go-Pg, Co-Gn, Co-Pg & Go-ME & recovered after they received leptin. But interestingly the mandibular width increased & long bones’ width increased.
- Ohrn et al [12] proposed that short upper face heights could be attributed to decrease level of

growth hormone which is down regulated by obese state. Nutritional deficiencies can significantly alter the functioning of endocrine glands which influences the dentition.

Milk and milk products: - These products should comprise about  $\frac{1}{4}$ th of the total dietary requirements. Strong bones and teeth rely on a diet that is rich in calcium. Dairy products provide us with calcium, Vitamin D, potassium, and even protein. Dairy products are an excellent choice for braces wearers because most dairy products are soft and require truly little chewing. Milk, milk shakes, yogurt (curd), and cheese are the commonly used milk products in Indian diets and their consumption by Orthodontic patients should be encouraged

## 4) Vitamins and minerals

**Vitamins and minerals:** - Even a trace amount has a profound impact on development of teeth and other dentofacial structures. Presence of optimum amount of Vitamins A, D and C and calcium and phosphorus during calcification ensures adequate and skeletal and dental growth. Cortical thinning, enlargement of medullary spaces and reduced osteoblastic and osteoclastic activity are other unfavourable skeletal effects that has been observed. [13] Calcium, Vitamin A, Vitamin D and Phosphorus are essential for the formation of bone and teeth. Deficiency of these nutrients causes retarded jaw, teeth and condylar growth. [14] Therefore a variety of amino acids, vitamin A, D and C, Calcium and Phosphorus must be present to ensure optimal calcification during the teeth formation and calcifying periods.

**Vitamin C:**-Tooth movement involves biologic response to orthodontic forces, which may be influence by Vitamin C. Lack of this vitamin also interferes with collagen synthesis thus affecting both periodontal ligament and formation of Osteoid. It also effects retention after orthodontic treatment as its deficiency leads to more relapse. Its main effect is on the periodontal ligament (PDL). [14-16] vitamin A:-deficiency causes keratinizing metaplasia of the epithelium, thus, increasing vulnerability to infections. [17]

**Vitamin B:** - deficiency is established as a cause of gingivitis, glossitis, angular cheilitis and oral mucositis. [18]

Folic acid: - deficiency is characterized by non-inflammatory necrosis of gingiva, periodontal ligament, and alveolar bone. [19]

## Vitamin-D:-

Vitamin D deficiency causes skull softening following decreased calcium deposition and increase the susceptibility for cleft lip and palate [20]. Vitamin D helps in metabolism of



calcium and phosphorous which are required for skeletal and dental growth. Vitamin D deficiency causes rickets and maxillary dysplasia, Closure of facial sutures is hampered leading to open bite, transverse hypodimension and misshapen palate [21]. The individual with magnesium deficiency may lead to habit of bruxism [22]

#### 5) Water

Dehydration in the body can have various oral manifestations like dry mouth, bad breath, increased risk of tooth decay etc. so one should be well hydrated while wearing orthodontic appliance.

### ROLE OF HORMONES IN ORTHODONTICS

Most of the functions of nervous system are executed by hormonal substances, and endocrine functions are controlled by nervous system.[23]

#### 1) Growth Hormone (GH)

It is a protein hormone, secreted by the acidophil of the anterior pituitary gland. It has no direct action upon bones, it acts through a substance called somatomedin secreted by liver.

Effects of Growth Hormone on Craniofacial Growth: If there is a deficiency of GH the length and depth of the face are inappropriately small for the child's age, with the face maintaining childlike convexity. Many studies have reported mandibular total length (Gnathion-Condylion) is reduced, primarily because of the small ramus height (Condylion- Gonion). In addition, the maxilla is significantly reduced, and there may be a comparable degree of reduction in the mandible. The maxilla is often retrognathic but is affected less than the mandible. Concerning cranial base size, many studies have reported that the posterior cranial base length is smaller than the anterior cranial base (N-S) length.

Effect on Dental Development: - Dental delay is less significant than height or bone delay. Dentition s delayed harmoniously, so that dental development (primary root resorption, secondary tooth formation and eruptive movement) displays the same degree of retardation.

GH replacement therapy: - facial convexity decreases with and its main effects condylar growth. Another study reported that growth in the Gnathion-Condylion and lower facial height(ANS-Me) are accelerated, whereas the cranial base length changes minimally.Cantu et al found that catch-up growth with GH therapy affects the anterior facial height, posterior facial height, and posterior cranial base.

#### 2) Prostaglandins (Pgs)

Yamasaki and associates in their experiment in rats found the synthesis of prostaglandins by orthodontic force, also

exogenous prostaglandins can produce bone resorption like orthodontic force. Various clinical and animal studies have identified the role of prostaglandins (PGE1 and PGE2) in stimulating bone resorption. They have reported a direct action of prostaglandins on osteoclasts in increasing their numbers and their capacity to form a ruffled border and effect bone resorption.

Lee et al also reported that systemic intravenous administration of PGE1 was more effective and produced more bone resorption than local injection Clinically and an increase in the number of osteoclasts and resorption lacunae, microscopically. Studies have also identified other agents such as growth factors (platelet-derived growth factors), hormones (parathormone [PTH]), and interleukins or other cytokines that induce PGE2 production, to effect bone remodelling and tooth movement. The two major Drawbacks associated with the use of prostaglandins as reported by them are: pain reaction and the need for frequent administration because of rapid metabolism of PGE2 in the lung.

#### 3) Corticosteroids

Corticosteroids are immunosuppressive and anti-inflammatory agents, widely used to treat pathological processes in medical and dental practice. The patients under orthodontic treatment represents variations in normal bone remodelling due to the use of these drugs. In the process of tooth eruption, however, cortisone has a special effect. Eruption rate is accelerated. Effects on bone and tooth movement Evidence indicates that the main effect of corticosteroids on bone tissue is direct inhibition of osteoblastic function and thus the decrease of total bone formation. Corticosteroids increase the rate of tooth movement, and since new bone formation can be difficult in treated patients, they decrease the stability of tooth movement and stability of orthodontic treatment in general.

#### 4) Estrogens

Estrogen is the most important hormone to affect bone metabolism in women. It monitors bone remodeling during reproductive life, and upkeep of maximum bone mass after menarche. Estrogens do not have any anabolic effects on bone tissue; they directly stimulate the bone forming activity of osteoblasts. Effect on tooth movement Studies have shown that Estrogen decreases the velocity of tooth movement. Oral contraceptives taken for extended periods of time can influence the rate of tooth movement. Androgens also inhibit bone resorption and modulate the growth of the muscular system and may affect the length and results of orthodontic treatment. Estrogen influences the composition and



degradation of collagen fibers in the periodontal ligaments and the remodeling of the alveolar bones.

While estrogen influences the deposition and cross-linking of collagen fibers, it also enhances the alkaline phosphatase (ALP) activity and the secretion of osteocalcin (OCN) and osteoprotegerin (OPG) in the periodontal ligament cells (PDLs). Rate of tooth movement is tied up with activity of osteoclasts. It inhibits activity of osteoclasts in a direct or indirect manner, thereby modulating bone resorption.

#### 5) Thyroid Hormones (Th)

Thyroid hormones are used for the treatment of hypothyroidism and used after thyroidectomy in substitutive therapy. Thyroxin administration leads to increased bone remodeling, increased bone resorptive activity, and reduced bone density. Thyroid disorders commonly affect craniofacial and dental structures. The dental and craniofacial retardation manifested under prolonged hypothyroid conditions differs from the isolated lack of GH. Cranial vault shows growth retardation in hypothyroidism, and reduced facial height in children with prolonged untreated hypothyroidism. Thyroxin administration seems to lead to increased bone remodeling, increased bone resorptive activity and reduced bone density. Thyroid hormones increase osteoclastic bone resorption in neonatal mouse calvarium by stimulation of prostaglandin synthesis

#### 6) Parathyroid hormone (PTH)

Relative studies have confirmed that parathyroid hormone could stimulate both osteoclast-mediated bone resorption and osteoblast-mediated bone formation, therefore accelerating the bone turnover rate. The ultimate effect of parathyroid hormone on bone remodelling is determined by the administration protocol. Continuous infusion of parathyroid hormone results in a catabolic effect and intermittent injection leads to an anabolic effect. Intermittent low-dose parathyroid hormone analogues have been widely administered in the clinical treatment of osteoporosis. Intermittent parathyroid hormone administration, results in an increase in osteoclastic resorptive activity. In turn, the resorptive activity increases the release of osteogenic growth factors from bone matrix and osteoclasts, and it stimulates bone remodelling.

#### 7) Calcitonin

It inhibits bone resorption by direct action on osteoclasts decreasing their ruffled surface which forms contact with resorptive pit. It also stimulates the activity of osteoblasts. Vitamin-D and its most active metabolite, vitamin-D<sub>3</sub>, together with parathyroid hormone and Calcitonin,

regulate the amount of calcium and phosphorus in the human organism. It promotes intestinal Ca<sup>2+</sup> and PO<sub>4</sub><sup>3-</sup> absorption. Vitamin-D<sub>3</sub> increases bone mass and thus reduce fractures in osteoporosis patients. Considering its beneficial effects on bone tissue, it may be assumed that it inhibits tooth movement. Because of its physiological role, it is considered to inhibit the tooth movement, consequently, delay in orthodontic treatment can be expected

So, Corticosteroid, parathyroid and thyroxin hormone have been shown to accelerate orthodontic tooth movement whereas Estrogens, Vitamin D<sub>3</sub> inhibit the rate of tooth movement, although no direct clinical evidence is available.

### EFFECT OF NUTRITION ON ORTHODONTIC TREATMENT

During an orthodontic treatment patient is instructed to avoid sticky, gummy, chewy or very hard food to circumvent appliance breakage and bracket debonding, which results into decreased fibre and carbohydrate intake and increased fat intake.

The orthodontic therapy is highly dependent on the good health of oral tissues as frequent ulcerations, inflamed oral tissues and compromised periodontal tissues negatively hamper the orthodontic therapy.

The unregulated sugar consumption, inadequate oral hygiene causes decalcification of teeth under the bands and brackets. The presence of brackets, wires, elastics, springs and other attachments interfere with patient's ability to maintain hygiene of teeth and brackets, which may lead to demineralization. The clinical observations suggest junction between bonding resin and enamel, especially gingival to bracket base to be the most common site of demineralization which can be seen as white spot lesions. [10]

The sticky foods and improper oral hygiene increase the susceptibility of teeth towards dental caries. Topical Fluoride application inhibits dental caries by conversion of hydroxylapatite crystals of enamel into less acid soluble fluorapatite. But excess fluoride can cause dental fluorosis characterized by brownish and corroded appearance of teeth.

The biologic responses initiated during orthodontic tooth movement involves complex coupling of osteoclastic and osteoblastic activities. Tooth movement requires simultaneous synchronic functioning of collagen metabolism which is dependent on adequate supply of Vitamin C for production of mature collagen. Thus, 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. Individuals with Vitamin C deficiency have unstable teeth and relapse faster after orthodontic treatment.

### **ORTHODONTIC TREATMENT AND BALANCED DIET**

A detailed diet history of the patient should be noted before orthodontic treatment, so that the orthodontist can guide the patient according to their food habits. Dairy products make up about ¼ of the total diet. They are strong source of vitamin C and regulates bone metabolism. Vegetables and fruits should be cut into small pieces and consumed, as they are necessary for growing patients. Citrus fruits like oranges and berries can be consumed 3-4 days after wire is changed. Fruit juices are always a good option. Eatables at room temperature are always preferred. Nuts and seeds are very hard and very small –two challenging aspects for braces wearers. During the duration of active orthodontic treatment, select nut spreads or coarsely grind your favorite nuts and seed.[11] Eating meat is difficult because it is fibrous and hard to chew. Tofu or cottage cheese provides a safe alternative to meat as a source of protein. Fleshy part of meat can be eaten after cutting it into small pieces and bone should be avoided.

## **II. DISCUSSION**

Concentrating on the healthier foods and nutritional food choices, dietary counseling and nutritional education corresponding to oral health have become an integral part of dental education. In 1987 guidelines for accreditation of dental schools by the American Dental Association stated that “the graduate must be competent to provide dietary counseling and nutritional education relevant to oral health.” Study of diet and nutrition is also a mandatory part of curriculum in Indian dental schools. [24]

Orthodontic treatment mobilizes and utilizes more nutrients by physical, physiologic and psychological stresses and rises the nutritional requirement of the patient.

The nutritional needs of adolescents are already stressed by growth and development as well as the emotional stress of puberty, thus maintenance of a well-balanced diet in orthodontic patients typically adolescents is great challenge. Fixed orthodontic treatment lasts for around 1½ to 3 years and, during this duration, certain dietary restrictions and modifications are advised. In addition, the use of alcohol or drugs may further

increase nutritional requirements. For example, oral contraceptive steroids increase the need for pyridoxine, foliates, and ascorbic acid. [25,26] The use of phenytoin by orthodontic patients with epilepsy represents another example of drug-induced vitamin requirement. An anticonvulsant-induced osteomalacia with increased osteocytes and osteoclastic resorption was shown to exist in epileptic orthodontic patients and was reversed with Vitamin D therapy. The orthodontist often advises their patients to eat soft food during treatment to avoid pressure sensitivity, but very few give clear-cut instructions or provide diet charts.

In Orthodontic appliance, elastics experience constant force expression, with considerable force degradation through the first day of use. [27] The effects of food simulating oral environments on dental polymeric restorative materials have been studied where various forms of degradation of polymeric restorative materials have been found to be enhanced when they were subjected to Coca-Cola, [28] ethanol / water, [29,30] lactic acid, citric acid, heptane, and alcohol / water [31] ethanol / artificial saliva. [32]

In the study of Abalos et al., [33] corrosive action of soft drinks with low pH on the surface of Ni-Ti wires was reported. A study conducted by Paulina Wołowiec et al. [34] where the results suggested that consumption of food products of low pH (such as fruit juices, coffee, yoghurt, and vinegar) may influence the oral cavity by increasing the release of Cr and Ni ions from orthodontic appliances. The unregulated sugar consumption, inadequate oral hygiene causes measurable demineralization, gingival to bands and brackets in a period of 4 weeks as reported by Featherstone and Glatz. [35]

To optimize patient's physiologic response to orthodontic treatment, it is advised to provide dietary guidance to orthodontic patients in choosing soft food diets. This includes obtaining nutrition history, evaluating the diet, educating the patient about diet components important for oral health, motivating the patient to improve diet, and follow-up to support patient's effort to change food behaviors. Patients with braces who prefer to foods such as cakes, pastries, ice creams, and cookies, which are high in simple sugars and fats, should be advised regarding the value of fruits, vegetables, grains, and cereals in the irregular diet. Nutrition goals for the orthodontic patient should be to eat a variety of foods including protein sources, dairy food, fruits, vegetables, and cereals and to limit salt, fat, and sugar intake.



Proper instructions and brief educational session after strapping up with Orthodontist on An orthodontic appliance friendly balanced diet

what to eat what not to eat and how to eat to keep the appliance intact and clean is required.

Sr No.	Food group	Main nutrients
1.	Cereals, grain products, rice and wheat flour, maize, rice flakes, and Maida	Energy, protein, invisible fats, Vitamins B and B2, folic acid, iron, and fiber
2.	Pulses - Legumes, Bengal gram, black gram, greengram, redgram, Rajmah, soyabean	Energy, protein, invisible fats, Vitamins B and B2, folic acid, calcium, iron, and fiber
3.	Milk and meat products	Protein, fat, Vitamin B2, calcium
4.	Meat and chicken-liver, fish, eggs	Protein, fat, and Vitamin B2
5.	Fruits - Apple, guava, tomato ripe, papaya, orange, sweet lime, watermelon	Fiber, Vitamin C, carotenoids
6.	Vegetables (green leafy)	Invisible fat, carotenoids, Vitamin B2, folic acid, iron, calcium fiber
7.	Other vegetables - Carrot, brinjal, Lady's finger, capsicum, beans, onion, cauliflower	Carotenoids, folic acid, calcium fiber
8.	Fat and sugar-butter, ghee, groundnut, coconut oil	Energy, fats, and essential fatty acids
9.	Sugar and jiggery	Energy

**BRACES-FRIENDLY EATING TIPS**

With braces in the mouth, it is very important avoid certain food items that can cause damage or breakage of orthodontic appliance as it can cause delay in treatment.

NEVER	THINK BEFORE YOU EAT	CAN EAT
Chewing gum, caramel, toffee and all sticky candy, ice cubes, popcorns kernels, raw apple or carrot, corn on cob, hard pretzels, pizza crust, chocolate chips, nuts, carbonated drinks.	Chips, chicken wings, raw vegetables, hard fruits when cut into small pieces, loose corns, crusty bread, high sugar foods	Potato chips, steamed vegetables, french fries, yoghurt, pudding, jelly, soup, cereal in milk, cheese, eggs, milk shakes, ice cream without nuts

**ABSOLUTELY NO" FOOD GROUP**

Sr No.	Food	Not to eat
1	<b>Gum</b>	sugarless or otherwise
2	<b>Sticky foods</b>	toffees, candies etc
3	<b>Hard food</b>	nuts (unless grinded), popcorn, corn on the cob, pizza crusts, ice, cookies

Maintain a healthy body during orthodontic treatment it is essential to follow a balanced diet. A diet is called balanced when it comprises of all the basic nutrients that the body

requires and meets the calorie requirements of the individual his/her age, sex, activity level etc in mind. A well-balanced diet for a typical Indian teenager is given below.



### INDIAN DIET CHART

Food group	Quantity	Sources
Cereals	300g	Wheat, Rice, Millets
Pulses	30g-Veg 60g-Nonveg	Sprouts/Fermented
Meat	30g	Egg/Chicken/Fish
Vegetables	300g	Peas, Carrot, Pumpkin, Beans, Green Leafy Vegetables
Fruits	100g	Orange, Apple, Papaya, Mango, Etc.
Milk And Milk Products	300g	Cheese, Curd, Etc.
Sugar	20g	Confectionary
Fats	20g	Oil/Butter/Ghee

### III. CONCLUSION

This article highlights the relationship between diet and orthodontic treatment and the nutritional strategies which can be effective to obtain good oral and general health in orthodontic patients.[6]

Nutrition and orthodontics are inter-related and inter-dependent on each other. Optimum amount of intake of balanced diet is important for growth and development of individual. Adequate nutrition also allows proper healing response during applied orthodontic forces for optimum patient's physiologic response to orthodontic treatment. Also maximum patient comfort has to be ensured during orthodontic treatment which minimally affects patients diet, thus proper nutrition intake is maintained.

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