

## Calcium and Oral Health: A Review



### Medical Science

**KEYWORDS :** Calcium, Nutrition, Oral health, Osteoporosis, Peak Bone Mass.

**Dr. Manu Rathee**

Senior Professor and Head, Department of Prosthodontics, Post Graduate Institute of Dental Sciences, Pt. B.D Sharma University of Health Sciences Rohtak, Haryana, India.

**Dr. Shefali Singla**

Associate Professor, Department of Prosthodontics DrHSJ Institute of Dental Sciences and Hospital Punjab University, handigarh, India.

**Dr. Amit Kumar Tamrakar**

Assistant Professor, Department of Prosthodontics, Faculty of Dentistry, Jamia Milia Islamia, New Delhi, India.

### ABSTRACT

*Calcium is vital for the proper development and maintenance of calcified oral tissues that includes hard dental tissues, the bony sockets and the jaw bones. The mineralized tooth structures i.e enamel, dentin and cementum, are different in composition than bone. The enamel covering of the coronal portion of the tooth is composed of large, densely packed hydroxyapatite crystals arranged in a unique pattern. Compared with bone, enamel has a higher ratio of mineral to water and organic material (96% mineral, 3% water, and <1% collagen). Enamel has no vascular or nerve supply after the tooth has been formed, and does not undergo remodelling after maturation is complete. On the tooth surface, demineralization and remineralization remains confined to localized areas.*

### INTRODUCTION

Calcium is an essential nutrient important for cell viability and other specific functions in the body. Most of the body calcium is found in the osseous tissue in the form of hydroxyapatite, an inorganic crystal made up of calcium and phosphorus. Only minimal amount of calcium is present in the teeth. Calcium is essential for bone growth as it is required for impregnation of the bone matrix with minerals. In addition, calcium plays a regulatory role in a number of specialised functions in the body. An intake of calcium in adequate amount is one of the important factors which are essential for acquiring bone mass and attaining Peak Bone Mass (PBM). Diet containing insufficient amount of calcium may lead to a low bone mineral density that may adversely affect bone health. Calcium plays an important role in muscle contraction, blood coagulation, neurotransmitter secretion and digestion. Plasma calcium concentration is regulated by kidney, gastrointestinal tract and bone through calciotropic hormones that include parathyroid hormone (PTH), calcitriol and calcitonin.

### Mineralized Tooth Structure

Diet can influence teeth after eruption through local effects. For example, calcium helps to maintain the mineral composition of teeth, which are subject to both demineralisation and remineralisation dependent on a number of dietary factors and the pH of the oral environment. Enamel demineralisation takes place below a pH of about 5.5 (the critical pH). The critical pH is inversely related to both the calcium and phosphate concentration of plaque and saliva, which are influenced by diet.

Acids are neutralized by saliva, raising the pH of the tooth surface above the critical pH, promoting remineralisation. The balance between remineralisation and demineralisation (and high and low pH) is favoured by reduced frequency of fermentable sugar consumption along with twice daily brushing with fluoridated toothpaste. The concentration of calcium in plaque influences demineralisation of tooth enamel and thus, risk of caries. The greater the concentration of calcium, the lower is the rate of demineralization and risk of dental decay. Also, the greater the concentration of calcium in plaque, the greater the fall in pH that can be tolerated before demineralisation occurs. The presence of calcium in foods can help protect against dental caries as this increases the concentration of calcium in plaque.

### Pre-eruptive Effects of Calcium

Mineralization of primary teeth begins around 4 months in-utero and of permanent teeth around birth, and continues till 6 to 13 years of age. During formation, the enamel, dentin and

cementum have vascular system to supply nutrients for mineralization, but this system is severed at the time of eruption. As a result, the time when an imbalance in calcium nutrition will have its major effect on tooth structure is during gestation and childhood.

### Role of Calcium in the Oral Health of Geriatric Patient

It is incumbent upon the dentist to provide the patient with the nutritional information for optimal oral health, as factors which are good for prevention of oral disease will also be equally good for prevention of general illness.<sup>2</sup> Unlike other nutrients, the calcium needs for older patients are less as than they were in young age. Though there are distinctive physiological, psychological and environmental problems that must be considered but these should not be inconspicuous. The best general advice for daily dietary intake is that daily diets should include meat, milk, vegetables and fruit and bread. There should be emphasis on good quality protein foods and a generous selection of vegetables and fruits and less emphasis on fats, starches, and sugars to avoid an excess of calories. For the individual geriatric new denture wearer each diet prescription should be based on an analysis and evaluation of his individual food habits and actual food intake. <sup>3</sup>Also, the physical nature of the diet should be consistent with the patient's ability and experience to swallow, chew, and bite with the dental prosthesis.

### Role of Calcium deficiency in the progress of periodontal diseases and osteoporosis

A reduction of bone mineralization aggravates pathological periodontal changes resulting in less support for the teeth. Decline in dietary intake of calcium and calcium phosphorus ratio may enhance the appearance of both these conditions by increasing bone resorption.<sup>4</sup> This type of bone loss affects the bones in descending order- jaw bones (mainly alveolar bones), cranial bones, ribs, vertebrae and long bones. Alveolar bone has the highest rate of renewal and is affected first and consequently is the most severely affected in the long term. Studies have shown that increased calcium intake improves the suffering of inflammatory processes and tooth mobility in patients having gingivitis. Insufficient dietary intake of calcium results in more severe gingival and periodontal diseases.<sup>5</sup> More studies are needed to better define the role of calcium in periodontal disease and to determine the extent to which calcium supplementation will modulate periodontal disease and tooth loss.

### Effects of calcium with vitamin D supplementation on alveolar ridge resorption

Studies have reported that subjects receiving a 1gm calcium

supplement daily for 12 months showed an increase in bone density in the mandible of approximately 12.5%. Adequate vitamin D is absolutely essential for absorption and metabolism of calcium.<sup>6</sup> Vitamin D deficiency is common in patients not exposed to significant amounts of natural sunlight. Mean alveolar bone loss for patients receiving the supplement was 36% less than that for patients receiving a placebo medication in a 1-year double-blind study.

The importance of providing supplemental vitamin D along with calcium in achieving retardation of bone resorption has been emphasized by various authors. Negative or inconclusive results in trials of calcium therapy without vitamin D have been reported by Smith and associates.

### Osteoporosis

Osteoporosis refers to lack of bone density or poverty of bone tissue. The disease is considered idiopathic, but it can be attributed to nutrition to a large degree. Extensive corticosteroid therapy can cause a secondary form of the disease, as the decrease of bone mass leads to increased porosity, brittleness, and easily resorbed and fractured bones.<sup>7</sup>

Calcium can be obtained only through dietary sources, but it is lost by the body through several mechanisms. Daily loss by renal clearance includes one to 200 mg and by digestive juices is 125 to 180 mg. Additional loss of calcium occurs in females due to several factors. Females are more prone to go on reducing diets with a decrease in the amounts of all nutrients ingested. During pregnancy, the foetus requires 400 mg calcium per day; during breastfeeding, an additional 300 mg of calcium per day is required. Loss of oestrogen and changes in hormonal balances at menopause also cause accelerated calcium loss. Any loss of calcium results in loss of bone density, resulting in an osteoporotic state.

### Calcium/Phosphorus ratio of the diet

The residual ridge resorption, a major oral disease, may also be a common oral manifestation of systemic bone disease. Among the many recognized systemic influences which affect the calcium deficiencies and bone resorption, calcium-phosphorus imbalances have been specifically implicated as contributing

factors in the pathogenesis of alveolar bone destruction and osteoporosis.<sup>8</sup> This ratio should be approximately 1: 1, but it is usually found to be much greater. Excess intake of phosphorus in the diet causes secondary hyperparathyroidism which in turn leads to more bone resorption. Wical and Swoope studied a group of edentulous patients and related bone loss to calcium-phosphorus ratios. Their study showed that patients with low calcium intake and calcium-phosphorus imbalances had severe mandibular bone resorption.

Most popular foods contain much phosphorus and little calcium. High phosphorus foods such as refined breads, cereals, and meat are staples of the diet. Even the foods high in calcium such as milk, non-processed cheeses and vegetables contain almost an equal amount of phosphorus.

### Treatment and prevention by nutritional supplementation

The intake of foods containing large amounts of phosphorus makes total dietary control of the calcium-phosphorus ratio ineffective. So, nutritional supplementation of the diet is logical and convenient alternative. A supplementation of 750 to 1,000 mg per day calcium and 375 IU vitamin D is suggested. Vitamin D supplementation in patients with coronary disease, impaired renal function, and atherosclerosis is cautioned.

### CONCLUSION

Of the many systemic influences which affect the bone responses of patients, dietary factors may be subject to the dentist's control just as are factors of dental treatment.<sup>9</sup> Nutritional deficiencies and imbalances, as well as mechanical factors, should receive consideration in diagnosis and treatment planning for dental patients. Dentists should be prepared to meet the responsibility of correcting dietary problems of their patients, either by themselves or by referral to qualified therapists.

## REFERENCE

1. Theobald HE. Dietary Calcium and Health. Nutrition Bulletin 2005; 30: 237-77. | 2. Nizel AE. Role of Nutrition in the Oral Health of the Aging Patient. Dent Clin North Am 1976; 20: 569-84. | 3. Sheiham A. The Relationship Among Dental Status, Nutrient Intake and Nutritional Status in Older People. J Dent Res. 2001; 80: 408-13. | 4. Ortega RM, Requejo AM, Encinas Sotillos A, Andres P, Lopez-Sobaler AM, Quintas E. Implication of Calcium Deficiency in the Progress of Periodontal Diseases and Osteoporosis. Nutr Hosp 1998; 13: 316-9. | 5. Nishida M, Grossi SG, Dunford RG, Ho AW, Trevisan M, Genco RJ. Calcium and the Risk for Periodontal Disease. J Periodontol 2000; 71: 1057-66. | 6. Wical KE. Effects of a Calcium and Vitamin D Supplement on Alveolar Ridge Resorption in Immediate Denture Patients. J Prosthet Dent 1979; 41: 4-11. | 7. Baxter JC. Relationship of Osteoporosis to Excessive Residual Ridge Resorption. J Prosthet Dent 1981; 46: 123-5. | 8. Wical KE, Swoope CC. Studies of Residual Ridge Resorption. Part II. The Relationship of Dietary Calcium and Phosphorus to Residual Ridge Resorption. J Prosthet Dent 1974; 32: 13-22. | 9. Krall EA. Calcium and Oral Health in Calcium in Human Health, Humana Press; 2006 p 319-25. |