33. Fluoride

Physiology

The essentiality of fluoride is debatable but since epidemiological studies have demonstrated in children an inverse relationship between the incidence of dental caries and their calculated intakes of fluoride, the element has been accepted as being beneficial to dental health [1,2]. Both topical and systemic fluoride replace hydroxyl moieties in enamel to form calcium fluoroapatite, which is less soluble in acid than is calcium hydroxyapatite, thus increasing resistance to demineralisation and improving mineralisation. Additionally, fluoride may have an antimicrobial effect on cariogenic oral microflora [2]. Ninety-five percent of systemic fluoride is in the skeleton and teeth. The concentration in bone increases with age and it has been suggested, but not proven conclusively, that fluoride may have a role in both the mineralisation of bone and the maintenance of peak bone mass [1].

Systemic homoeostasis of fluoride is achieved by the kidneys [3].

Deficiency and excess

Apart from an increased risk of susceptibility to dental caries, there are no well documented effects arising from low intakes of fluoride. On the other hand fluoride excess (fluorosis) is endemic in many parts of the world. An early feature of this is patchy demineralisation (mottling) of the tooth enamel, more usually of the permanent dentition. In terms of intake, this affects populations with intakes approximating 0.1 mg/kg/d [4]. This problem occurs in 10 % of children in areas with a water supply containing 1 mg (50 mol) fluoride/kg. Chronic exposure to high intakes (10-25 mg/d, resulting for example from consuming water supplies containing 15 mg/kg) results in a sclerotic calcification of bones, ligaments, tendons and interosseous membranes. This manifests as debilitating musculo-skeletal deformities which have been noted particularly in India, East Africa, the Persian Gulf and China [5]. However, the overall intake of fluoride, rather than the concentration in water is crucial in the pathogenesis of this syndrome and early skeletal features of fluorosis have been detected in populations from arid zones with water supplies containing less than 15 mg/kg.

Requirements

There does not appear to be a specific physiological requirement for fluoride and no specific recommendations have been made. Acute toxicity and perhaps death have been reported in adults exposed to intakes of 0.5 to 2.6 g/d [6].

References

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