

Guest editorial

Caffeine and bone metabolism: is there any relevance to the dentist?

Bone is a dynamic tissue highly ordered with support, protection, and mobility functions of the human body, in addition to be an important mineral reservoir. Bone physiology is controlled by a complex interaction of mechanical, hormonal, circulatory, metabolic, and nutritional factors so that changes in the balance reflect in the deposition and resorption functions exerted by bone cells. The dentist and some other health professionals are daily related to the diagnosis and treatment of patients requiring interventions involving the direct or indirect handling of bone tissue, so that the knowledge of the alterations in the aforementioned factors is of paramount importance.

Caffeine, a methylxanthine widely consumed in the diet of the world population, is present in coffee, tea, soft drinks, food, medications, and dietary supplements. According to the Food and Drug Administration [9], caffeine intake in the US population reaches 300 mg person/day (approximately four espresso cups), and the largest sources are coffee, soft drinks, and teas. Despite the large consumption of caffeine, its consequences for bone metabolism are still the controversy, but studies have shown harmful effects with acute and chronic exposure to this substance, or even when associated with certain systemic physiological changes such as osteoporosis.

With the large number of dental surgical procedures such as extractions, bone reconstruction, and implant installation, which depend on adequate bone repair, is it possible that caffeine consumption by patients may alter the metabolism of the alveolar bone? In humans, there are no studies that really show/quantify a deleterious effect on the alveolar process, but in animals some interesting information can be found mainly in rats. Concerning to the repair of post-extraction tooth socket, both the daily ingestion of coffee (chronic) and intraperitoneally injected caffeine (acute) show a delay of the entire repair process, culminating with histologically immature bone tissue with volume of 40% and 60% lower than that of controls, respectively [7]. With regard to bone reconstructive procedures, the literature is still poor on the subject, only one study performed in animals relates the use of caffeine and its influence on the autogenous bone integration process, whose results demonstrated the development of foreign body inflammatory reaction on the surface of the bone fragment, leading to low capacity of osteoid matrix synthesis around the graft material [6].

The caffeine mechanisms of action on bone are not entirely clear, but have been classified as direct and indirect. The latter occurs secondary to changes in calcium and phosphorous homeostasis, caused by changes either in hormones or in the absorption and excretion regulators. Lacerda et al. [3] demonstrated that coffee chronically ingested by rats was responsible for decreasing bone mineral density, higher calcium levels in plasma, and also by its high concentration in the urine, which demonstrates the ability to mobilize bone calcium into the blood with the consequent elimination of this mineral in the urine. The direct actions are associated with alterations in the activity of bone cells, and studies have shown changes in differentiation, proliferation, and matrix synthesis, and mineralization of osteocytes and osteoblasts. Caffeine can also modulate various aspects of inflammatory and immune adaptive/innate response, altering the concentration of mediators with important functions also in repair.

Considering osteoporosis, recent studies have reported excessive consumption of caffeine as an accelerating factor for this pathology development [8]. Concerning to the major consequence of this disease – bone fractures –, there is no consensus whether caffeine may increase the risk of such an event occurs. Systematic reviews on the subject affirm that daily coffee consumption is associated with an increased risk of fractures especially in women [4]. On the other hand, a study on Swedish women showed that long-term coffee consumption (more than four cups/day) caused a reduction in bone density between 2% and 4%, but not related to increased risk of bone fractures [2].

And regarding to the osteoporotic patients and larger consumer of beverages containing caffeine, is there any impact on bone healing? Studies on animals also show that osteoporosis associated with caffeine intake is able to increase bone loss around teeth with experimentally induced periodontal disease, reduce the area of trabecular bone around healthy teeth, and decrease post-extraction cellular

reparative capacity tooth [1]. Also, in bone repair models using dental alveoli of rats, the osteoporosis by itself is able to reduce synthesized bone volume in 40% and in the presence of caffeine this effect is exacerbated, so that the value reaches 61% compared to controls, in addition to provide the development of tiny and hypomineralized bone trabeculae [5].

It is a fact that caffeine exerts a detrimental effect on bone metabolism in general, including the alveolar bone. Therefore, the dentist must have the knowledge that bone metabolism is controlled by various endogenous and exogenous factors, including caffeine, which can have a synergistic effect with systemic physiological changes, generating a deleterious effect on the various procedures involving bone. Many studies are still needed, both in animals and in humans, in order to establish the real alveolar bone changes, its clinical implications, and the possible safe daily limit for caffeine consumption, a substance so widespread and necessary for humans of the modern world.

References

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