Journal of Research in Medical and Dental Science
2020, Volume 8, Issue 4, Page No: 162-165

Available Online at: www.jrmds.in
eISSN No. 2347-2367: pISSN No. 2347-2545

Dental Metals: Is There a Health Risk?

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ABSTRACT

Metals have been used extensively in industry, agriculture, but also in dentistry field. They are always present in our environment and represent a danger in the long term. The problem is that our body is not able to totally eliminate these metals, which accumulate there. In excess, they can represent a risk to our health. The purpose of this literature review is therefore to study these risks. The mouths of our patients contain a real mosaic of metals. Unaware of the danger, we have multiplied the alloys (there are more than 1,000) while some metals should never coexist in the same mouth. There are sometimes more than 30 different metallic materials in the same oral cavity, some are apparent, others buried inside the tooth roots, in the form of pivots or covered by the ceramic. The risks involved in the use of dental metals justify the public health interest that any therapist must give to galvanic phenomena in the oral cavity. Whenever it's possible, preference should be given to prosthetic solutions that do not include metal. If the use of metal is essential for technical or economic reasons, it is imperative to keep the same alloy for all work. In addition, and concerning the field of research, it is necessary to carry out more high-level studies of scientific evidence related to the monitoring of dental metal intoxication and the action to be taken in order to standardize the protocols for taking in charge.

Key words: Dental alloys, Galvanic corrosion, Intoxication, Global health

HOW TO CITE THIS ARTICLE: Saida El Khayati, Karim El Khatib1, Amal El Yamani, Dental Metals: Is There a Health Risk? J Res Med Dent Sci, 2020, 8 (4):162-165.

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Received: 26/06/2020

Accepted: 24/07/2020

INTRODUCTION

The metals used in dentistry are always present in our environment and represent a long-term danger by accumulating in bones and organs over time. The problem is that our body is not able to eliminate these metals, which accumulate there. In excess, these metals can represent a real risk for our health.

Unaware of the danger, we have multiplied the different alloys (there are more than 1,000) while certain metals should never coexist in the same mouth. There are sometimes more than 30 different materials in the same oral cavity, some are apparent, others buried inside the dental roots. Some alloys are covered by ceramic or resins and are therefore invisible. The objective of this work is therefore to confirm or affirm these risks incurred and to deduce, if necessary, alternative solutions [1].

METHODS

In order to meet the objective of this work, we carried out a literature review. To identify the studies included or considered in this review, we adopted a research strategy based on the interrogation of three bibliographic, medical and scientific databases.

Pubmed (MEDLINE)

Science direct

Cochrane library (CENTRAL)

The search strategy was built by using keywords combined in as many steps as necessary with the Boolean operator "AND" and "OR".

For the MEDELINE database, four keywords, chosen according to the "Medical Subject Headings" (MeSH), were used for the research: 1 dental alloys, 2 galvanic corrosion, 3 intoxication, 4 global health. In manual search, the bibliographic references of the original journals and articles were crossed to identify additional studies.

CURRENT STATE OF KNOWLEDGE

Any metal placed in the mouth inevitably reacts to contact with saliva. This action results in corrosion which is accompanied by the production of electric micro-currents called oral galvanism; concept known for over 100 years. When, in the oral cavity, alloys of different compositions are present, differences appear in electrical potentials which can reach up to 1500 mV and even more is a real storm on a cellular scale [2].

Currently, it is worrying to note that the functioning potential of cell membranes (neurons) is around 45 mV (Nobel Prize 1991, B. Sakmann and E. Neher) [3]. However, during sleep, the contact between the dental arches is not fixed, the continuous galvanic current is therefore transformed into pulses; disturbing electrical information from the patient's neuro-vegetative system (headache, chronic fatigue, memory loss, sleep deprivation and even irritability). The pH and chemical composition of saliva at certain moments of the day can fluctuate and modify the electrical potential of one or more metals present in the oral cavity [1]. When two different metals form a battery, the most reactive metal element gradually goes into solution as ions. Thus 21 days of experimentation are enough to show the corrosion of amalgams, hooks in cobalt chromium and the increase in the concentration of metal ions in the enamel and dentin of the teeth concerned [4]. We have known for several decades that our cellular processes are governed by specific enzymes, more than 600 of which are metallo-enzymes that can be selectively blocked by the metal ions released following the galvanic current [5].

Each metal entering into reaction releases one or more electrons and this phenomenon is accompanied by a difference in potentials measurable in millivolts (mV). The Sargent firm (Chicago) published in 1963 a cursor scale entitled “Sargent Chemical Predictor” making it possible to predict which metals are able to move mutually in a reaction where they would be brought into contact. So when we observe the lower branch of the maxillary nerve and the distribution of its dendrites at each dental root, we can understand that a trigeminal neuralgia can have its seat as a result of a galvanic effect (electrical micro-discharges) propagating from obturation to the nerve [1].

The diagnosis of metal poisoning can be carried out by blood tests, urine tests but also by chemical analyzes in the hair. But certain elements such as mercury are only visible in the blood or urine for a noticeably short time. Once fixed in the organs, it is much more difficult to detect them. In case of poisoning, doctors will prescribe a chemical chelation treatment. The body can then eliminate this compound more easily than heavy metals [6].

In addition to these chelators, the phenomena of temporary passivation or depolarization can either slow down or activate the passage of ions in solution, but the chewing of food and bruxism constantly erode the thin layers of oxide and release these substances into the digestive tract where gastric hydrochloric acid will contribute to the dissolution of finely divided metal oxides [7].

The symptoms of metal poisoning can vary depending on the compound (s) involved and depending on the person, which makes its diagnosis complex. The most frequent signals are chronic fatigue, headaches, back pain, mental disorders (irritability, depression, anger, emotional instability ...), digestive disorders (diarrhea, nausea, vomiting) or still sleep disturbances. Currently, 28 different metals (and 2 non-metals) are used in the production of metallic dental prostheses. The main metals, quantitatively, are Beryllium, Aluminum, Titanium, Tantalum, Manganese, Ruthenium, Chromium, Gallium, Germanium, Iron, Cobalt, Zinc, Nickel , Indium, Tin, Molybdenum, Copper, Palladium, Zirconium, Rhodium, Iridium, Mercury, Platinum, Silver, and Gold [1].

Any metal placed in the mouth will be dissolved by a metal located at a lower level of the redox scale, for example, the nickel present in an alloy can cause the dissolution of iron, gold is capable of dissolving nickel, and gallium is active on aluminum but also beryllium. The carcinogenic power of Beryllium, even in traces, is no longer to be demonstrated, because this metal located at the very top of the redox table inevitably goes into solution when it is put in the presence of any other metal. And yet many people still have beryllium alloys in their mouths [8].

The chromium VI ion can be bioaccumulated by various organisms and it is a proven carcinogen (classified as a definite carcinogen validated by the International Agency for Research on Cancer). Chronic exposure to chromium VI

leads to gastrointestinal (diarrhea, abdominal pain, vomiting) and hematological (anemia, leukocytosis and immature neutrophils) effects [9]. Copper can also be toxic. Indeed, it will increase the formation of reactive oxygen species, responsible for oxidative stress. Large doses of copper can cause irreversible damage to the kidneys and liver and lead to death.

Chronic exposure to copper can cause irritation of affected areas, including mucous membranes, nasal cavity, eyes. It causes headaches, upset stomach, dizziness, digestive disorders such as vomiting and diarrhea. During chronic copper poisoning, it is exceedingly difficult to establish the reality of this poisoning; copper is stored in the liver and cannot be measured in the blood. It is necessary to wait until the hepatic storage capacity is exceeded to find traces of it during blood tests [10]. In developed countries, dental amalgams are the primary source of exposure to mercury; after 20 years, an amalgam contains only 5% of its initial mass of mercury. According to the Center for Disease Control (CDC) in the United States, one in twelve women of childbearing age has high enough mercury in the blood to endanger the neurological development of the fetus [11]. In the form of vapor, mercury is toxic to the respiratory tract and dissolves in the blood; it then attacks the kidneys, the brain, and the nervous system. In pregnant women, it crosses the placental barrier to reach the fetus. Breast milk can also be contaminated [12].

Several studies have established a link between exposure to mercury and the development of neurological diseases such as multiple sclerosis, Alzheimer's, or Parkinson's disease, as well as patients who saw their health improve after the withdrawal of dental amalgams [13]. For lead, the main symptoms of poisoning are abdominal pain, asthenia, headache, stunting, and mental retardation. Due to experimental data, the International Agency for Research on Cancer (IARC) has classified lead and its inorganic derivatives as Group 2B (possibly carcinogenic to humans) [14].

The simple nickel metal body is not very toxic but has a strong allergenic power. Ingestion of nickel ions causes digestive disorders (nausea, vomiting, and diarrhea). Over 12% of the general population is allergic to nickel, the most frequent reaction is contact dermatitis. Chronic exposure to nickel is a risk factor for lung and nose cancer. Metals are stored mainly in the bones, liver, kidneys, and brain. They can affect the nervous system, kidney, liver, and respiratory functions. Some, like cadmium, arsenic, nickel, and chromium are carcinogenic. Exposure to large doses of heavy metals is therefore involved in many severe pathologies such as multiple sclerosis, neurodegenerative diseases (Alzheimer's and Parkinson's disease), lung, respiratory and digestive tract cancers, or even renal failure. They could even play a role in triggering psychological and neurological disorders such as autism.

The link between dental metals and pathologies is difficult to establish, in the absence of associated pathologies. In addition, almost the entire population is exposed to dental metals: it is difficult to find "witnesses" who have not undergone a placental transfer and have never had metal restorations. Finally, the genetic variability, determining the detoxification capacities of each, is important [15]. The diagnosis of dental metal poisoning is not easy. The concentrations of the blood and urine metals are useful for acute poisoning but are not good indicators for long-term poisoning. In low doses, metal ions are trapped inside organs, including the brain, where they accumulate for decades. It is therefore impossible most of the time to obtain a direct measurement of impregnation by a biopsy, it is necessary to use either chelators capable of recovering part of the ions or mercury trapped, or indirect indicators (biomarkers).

Any therapist should, in front of patients suffering from pathologies of doubtful unknown etiology or autoimmune disease, ask themselves whether the metal ions which escape from their restorations could have contributed to their symptoms. The patients must be truly diagnosed and then treated [16].

Therefore, dental metals, as a major source of intoxication for the general population, should be considered in the differential diagnosis of patients examined for neuropsychiatric problems or short-term memory loss [2]. Once the poisoning is diagnosed, the patient can initiate a detoxification, which often turns out to be long and delicate. The few metal and especially mercury chelators are not without toxicity, and their intake must be subject to careful medical

monitoring. Since these chelators do not cross the blood-brain barrier (BBB), they cannot lower the brain impregnation [17]. A new molecule, crossing the BBB and increasing the cellular concentration of glutathione, is now available, but it has not yet been the subject of scientific publications.

CONCLUSION

The risks incurred using dental metals justify, in public health, the interest that any dental surgeon must pay to galvanic phenomena in the oral cavity. Whenever possible, use prosthetic solutions that do not include metal. Technological progress now makes it possible to produce implants, crowns and bridges in zirconia, a very solid ceramic, better tolerated than metal. These prostheses, more aesthetic than those with metal, must be favored whenever the conditions of realization allow it.

If the use of metal is essential for technical or economic reasons, it is imperative to keep the same alloy for all work. The name and exact composition of the alloy must be carefully recorded in the dental records for follow-up. Furthermore, and concerning the field of research, it is necessary to carry out more studies with a high level of scientific evidence in connection with the monitoring of metal intoxication and the course of action to be followed in order to standardize the protocols for taking charge.

WHAT IS KNOWN ABOUT THIS SUBJECT?

The concept of metallic identity card is almost nonexistent

Dental amalgams are banned in some countries and still used in others

The harmful effects of the multiplication of dental metals in the oral cavity are little known.

WHAT'S NEW IN OUR PAPER

Interest of the metallic identity card in the prevention of diseases induced by metals.

The risk of using different dental alloys in the same patient based on the concept of evidence-based medicine.

CONFLICTS OF INTEREST

Authors do not declare any conflict of interest.

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