

Determination of vitamin D level in dental offices : Who, when and how to treat ?

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Several studies are showing the influence of metabolic factors on global and oral health.

Glucose, vitamin D and cholesterol are the major metabolic factors.

Vitamin D is known since the beginning of the XXth century, after the discovery of its involvement in ricket occurrence. Since P. Lui et R. Modlin's paper in Science in 2006 (1), the interest in vitamin D didn't stop growing.

Vitamin D papers are now several thousands per year. Indeed, this hormone is involved in numerous biologic process. Its crucial role in bone metabolism is no longer to develop, but its involvement in others non skeletal diseases like cancer, auto-immune diseases, diabetes, allergy, depression, cognitive decline, muscle weakness, make it one of the « key element » of health (2). Recent studies also underline its involvement in several dental diseases.

A. VITAMIN D : Metabolism & Clinical involments

1. Metabolism

Vitamin D is an hormon from the steroid family, which exists under 2 different biologic equivalent forms : D2 and D3.

- Vitamin D2 or ergocalciferol, from dietary intakes
- Vitamin D2 or cholecalciferol, after sunny exposure or from dietary intakes

After intestinal absorption, the 2 forms are metabolised in the liver and transformed in the kidney in $1,25(OH)_2 D2$ ou $D3$, wich are the circulating metabolites tested in blood.

The principal source of vitamin D is the skin after sun exposure (By conversion of the 7- dehydrocholesterol, of the cholesterol family). Very few food naturally contains vitamin D, like oily fishes (More in wild fishes compared to raised ones), cold liver oil, cereals, soja etc.

In some countries, especially in North America and northern Europe, several products are fortified in vitamin D like milk, butter, yogurts etc. Vitamin D can also be found in dietary complements (4).

2. Role of vitamin D

Vitamin D is one of the major hormons of calcium-phosphorus metabolism. Without it, only 10% of the calcium and 60% of the phosphorus is absorbed (3). It also interact through in numerous tissues by its receptor, the VDR (Vitamin D Receptor), present in different kind of cells : Bone, skin, intestin, immune system, ovaries, explaining the numerous dysfunctions associated with its deficiency (5).

In case of vitamin D deficiency, the parathyroid hormon (PTH) secretion is increased, which lead to an increase of osteoclasts activity, and so a bone resorption.

It's also a key factor in immunity : The micro organisms defense is organised around immune cells with « human antibiotics » production, like *defensine* or *cathelicidine*, but under conditions of an adequat level of vitamin D (1).

Finally it is involved in glucose metabolism : A diet poor in vitamin D can scientifically damaged brain proteins, encouraging cognitive decline and occurrence of Parkinson and Alzheimer disease in middle age adults and the elderly (6,7).

Consequences of a vitamin D defect

- Increased risk of cancer (8)(9)
- Increased risk of infection (1)
- Increased risk of diabetes 1 (11) and 2 (12)
- Increased risk of premature birth (1)
- Worsening of asthma (13)
- Muscle weakness (14)
- Osteomalacia (1)
- Depression, schizophrenia (15)(16)

3. Dose and physiological levels

Known institutions have established a consensus of the minimal level : Around 30ng/mL.

Under 10-15 ng/mL, the employed term is severe deficiency. Between those we talk about deficiency. For some pathologies like cancer, the minimum required level seems to be higher : around 50 ng/mL (9).

On the opposite, vitamin D intoxication is a very rare phenomenon because of its high value: from 150 to 250 ng/mL according to different studies, thanks to the kidney action which limit its production. Vitamin D toxicity appears after prolonged ingestion of high doses (More than 10 000 IU a day) (17).

4. Epidemiology

Numerous specialized authors consider the vitamin D deficiency as a pandemic situation (18, 19).

The SUVIMAX investigation, helded in France in 2011 found 78% of deficient patients, more among the feminine population (20). Some studies express that 73% of the population has a vitamin D level under 20 ng/mL in winter (21).

The main reason is the insufficient sun exposure. People living in sunny area are not spared. This is due to our way of living : Vitamin D synthesis is limited by clothes, transports ... Vitamin D absorption is also limited by colored skin.

Unfortunately, dietary intakes are often too low to compensate a limited exposure. Latitudes and seasons also have an effect on the synthesis of this hormon.

The elderly are almost always deficient, because of their limited sun exposure but also by a decreased skin production of vitamin D of 75% compared to young adults (4). This is the reason why the world consensus on vitamin D recommend a systematic supplementation for people above 65 years old without any lab control, even without risk factors.

Other causes of deficiency also have been showed like malabsorption diseases (Crohn disease, coeliac illness...) or long term corticotherapy.

5. Vitamine D & dentistry

Studies on vitamin D involvement on oral cavity are still too few and too recent but some ideas are clearing up. A deficiency would increase the risk of periodontitis through a more expression of RANK L, responsible of the osteoclasts activity (22,23) but also a decrease of the bone density (24). Vitamin D deficiency would also increase the teeth lost, still linked with bone metabolism (25) and a poor resistance to infections.

The link between child carious risk and vitamin D level has been showed in some studies but results are still contradictory (26, 27, 28). But it's involvement in MIH (Molar – Incisor – Hypomineralization) has been statistically proved (29).

In regards to implantology, vitamin D slowly appears to be a key factor, improving osseointegration, given by local (30) or systemic (31, 32) ways, defense against infection, like during bone grafts.

Recently, it was shown in the university at Buffalo, that antidepressants, commonly used to treat anxiety, pain and other disorders, quadruple the risk of dental implant failure, according to a new pilot study. Each year of

antidepressant use doubled the odds of failure. We believe that the main factor is the deficiency of vit.D, which is frequently detected in these patients, than the direct effect from the medication (10)

B. PRESENTATION OF DIFFERENTS CLINICAL SERIES

Regarding the latest paper on vitamin D world population's status (3), we wanted to analyse The prevalence of vitamin D deficiency in various populations, in particular the one in a dental or oral surgery consultation.

A. Method

3 different populations have been tested in 25 (OH) vitamin D2+D3 :

- The first one (Serie 1) is about patients before an implant surgery in two private offices in France. It represent 288 persons, from 18 to 83 years old, with an average age of 61,5 years.
- Serie n°2 is about 48 patients before a maxillofacial cancer surgery in Francfort Hospital (Germany), from 31 to 93 years old with an average age of 63 years.
- The third one is composed of the medical staff in Francfort Hospital (Germany) : 24 adults from 23 to 80 years old, with an average age of 49,8 ans.

B. Results

- Serie 1 : *Figure 1* : On 288 patients, only 68, namely 23,6% had an adequate level of vitamin D, higher than 30ng/mL. Thus 76,2% have and inadequat level with 5,3% with severe deficiency (under 10ng/mL)

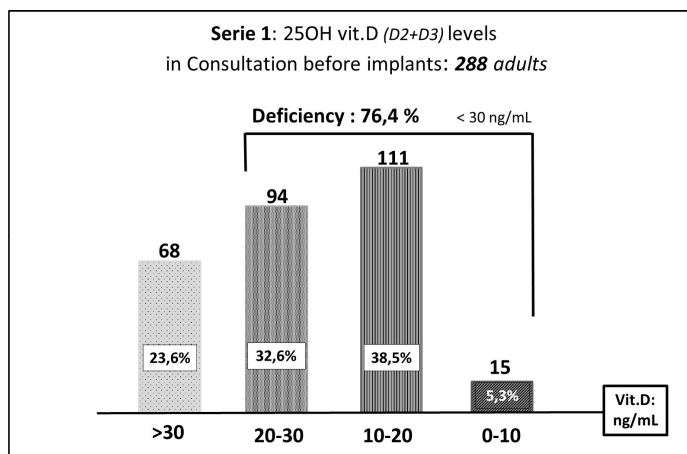


Figure 1 : Serie 1 : Determination of vitamin D level of patients before an implant placement

- Serie 2 : *Figure 2* : The percentage of patient with vitamin D deficiency is similar to serie 1 with 79,2% of inadequate level. But cancerous patients are more severely touched, indeed 31,3% are severely deficient.

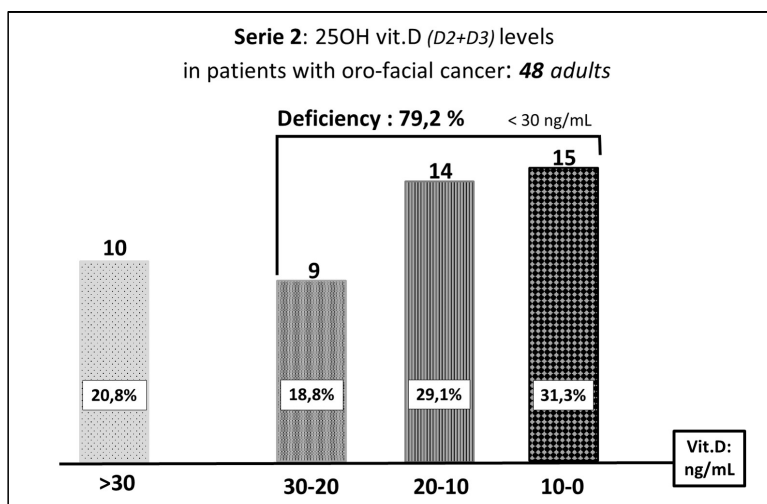


Figure 2 : Serie 2 : Determination of vitamin D level of patients before maxillofacial cancer

- Serie 3 : *Figure 3* : Medical staff is more deficient than the general population. Severe deficiency concern 45,8%. Only 3 persons out of 24, or 12,5% have a vitamin D level above 30ng/mL.

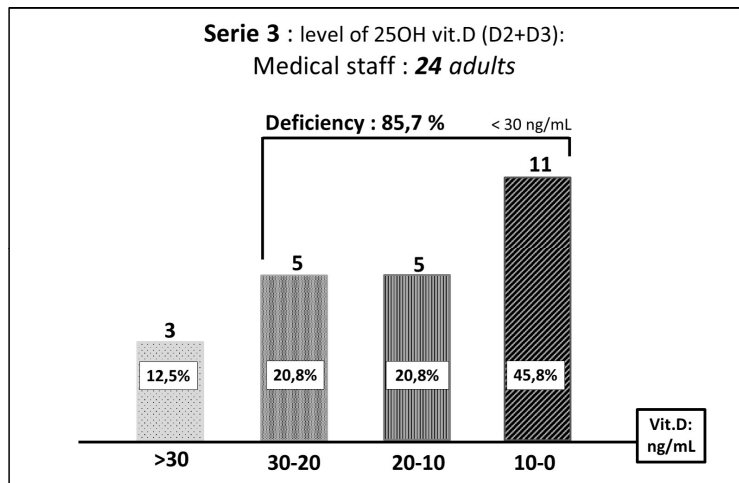


Figure 3 : Série 3 : Determination of vitamin D level in doctors and surgeons.

C. Discussion

These tests confirm the importance of the vitamin D deficiency : Above 78%, all series together, which match the latest studies.

The cancerous population is more deficient than the general population met in a dental office. This correlate the literature and the protective effect of vitamin D against several types of cancer (33, 34, 35). The poor sun exposure in Germany also have an impact of deficiency level.

Finally, for the medical staff, the high amount of time spent in the hospital, without any sun exposure leads to dramatic vitamin D level. These results are similar to previous studies (36)(37)

This study has to be continued to obtain more homogeneous results.

These results encourage us to consider a more definitive supplementation for our patients. The aim here is not only to balance the level for the surgery but also to achieve a constant homeostasis at long term. The vitamin D level determination become a necessity in pre-op check up in dentistry, for implant placement or bone graft Osseointegration. It appears that the bone or periodontal treatment stability will depend on the preservation of an adequate vitamin D level.

Effect of surgery on vitamin D levels

Any surgery leads to an oxydative stress, which causes an over consumption of vitamin D. This could explain why some patients, tested just after surgery, had a lower post op vitamin D level.

But hypercholesterolemia also exaggerate this oxidative stress

Thus, it will be logical to consider a higher supplementation to obtain a level much higher than 30 ng/mL. Would a level of 50ng/mL in pre op, be more appropriate ? Current studies are trying to answer this question. First results show a real improvement in surgical outcomes, especially in cancer surgery. It also have to be remembered that vitamin D has a protective effect against oxydative stress : At physiological concentration, it protects cells against this stress (40).

Link with hypercholesterolemia

In our study, we also tested the cholesterol levels (LDL and HDL) in pre-implant consultation patients. Among patients with vitamin D insufficiency, 44,6% had high LDL cholesterol levels (> 1,4g/L). This study confirms that those 2 factors, vitamin D and LDL cholesterol are linked (38)(39). Indeed vitamin D and cholesterol share the same precursor: the 7-dehydrocholesterol. Both have an impact on bone metabolism. Low vitamin D level or high LDL cholesterol increase inflammatory level and thus, osteoclastogenesis and bone resorption

Moreover, by treating the cholesterol with statins, the choice treatment, the vitamin D levels are found higher (38). It seems that these two key factors of global health are inter-connected and treating one is also improving the other.

C. CONCLUSIONS & WHAT TO DO

1. Who and when to test ?

In pre op, every patient with risk factors or consequences of vitamin D deficiency (like chronic periodontitis, chronic infection, allergy..) should be tested.

This test can also be interesting before implant placements or before bone grafts.

As shown in numerous studies, age isn't important. Young adults can also be deficient. The elderly is always considered as deficient but laboratory assays could be used to adapt the supplementation.

2. Elements suggesting a deficiency

- Individual : age, obesity, pregnancy
- Clinical : Muscular and skeletal non specific pain
- Spontaneous fractures, kidney chronic diseases, tiredness, drinking and smoking habits, depression
- Radiological : Decreased bone density
- Biological : Increased parathyroid hormone (PTH), hypocalcemia

3. What to do

The daily consumption of the body in vitamin D is about 2000 to 4000 IU (4). Daily intakes should compensate these. For the healthy population, the classic supplementation is about 800 to 1200 IU per day, or 50 000 IU per month, without any risk of toxicity. Population at risk should obviously receive higher doses.

Supplementation can be done in several ways :

- Drops : 200 UI to 2000 IU per drop : 1 drop a day
- Vials : 100 000 IU, 3 to 4 times a year
- Tablets : 200 to 1000 IU : 1 tablet a day

For a shock treatment, 2 or 4 intakes of 100 000 IU has to be taken, spaced of 15 days, according the severity of the deficiency.

4. Conclusion

This study is just a partial approach of the vitamin D problem. But it seems obvious that vitamin D is a key factor in bone and periodontal homeostasis. Patients and practitioners are both concerned by vitamin D deficiency. Dysfunction of the cholesterol metabolism is often associated (Almost one out of two). The recommendation of pre op checking appears obvious because the diagnosis of vitamin D deficiency will induce a life time treatment for the maintain of the best bone remodelling. We believe that the pre op supplementation should rise the objective of 50ng/mL in order to get more protection during the surgical time.

Checking both Vit. D and LDL cholesterol is not a non-sense as their metabolism are linked and LDL cholesterol is also a factor of high inflammatory level and deterioration of the bone health.

Further studies will be necessary to better understand involvements and consequences of this deficiency and also the potential benefits of a higher pre op supplementation in the dental field.

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