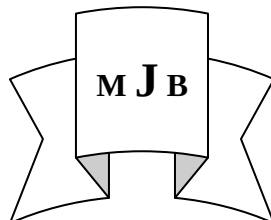


Dental Manifestation of Generalized Enamel Hypoplasia and the Calcium Role Due To Environmental Vitamin D Deficiency in Rickets and Osteomalacia Patients

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Abstract

Purpose: The aim of this study was detection of the aesthetic and functional defect of the teeth and the role of calcium and environmental vitamin D deficiency in adult male and female patients with generalized enamel hypoplasia.

Materials and Methods: A 25 female and male patients with yellowish discoloration of all their teeth. They complained of sensitivity to hot and cold and difficulty in masticatory function.

Medical history: They were complaining from rickets, softening and weakening of the bones in childhood as diagnostic. This can be caused by vitamin D and calcium deficiency as well as variety of metabolic bone disorders and abnormal dental development during infancy and adolescence.

Results: All the patients have low serum calcium even those who took treatment continuously and total calcium 8.33 ± 1.46 mg/d in comparison with normal range in control group in my study 10.79 ± 2.19 mg/ dl.

Dental features of rickets include enamel hypoplasia and delayed tooth eruption due to failure of tooth mineralization. This details from diagnosis allowed logical treatment sequence. The importance of treating the generalized enamel hypoplasia patient was not only from a functional point, but also from psychological health point. The complexity of the treatment of these cases required careful and special considerations of patient expectations for a successful outcome of the treatment.

Conclusion: The clinical study concluded that the defect in the teeth will be a big problems for most of patients as esthetic , functional was done and psychological problems, so I did restoration for 5 patients with generalized enamel hypoplasia, this should be oriented and represented a big challenge toward the aesthetic and functional rehabilitation. A concordant approach of generalized enamel hypoplasia with use of full metal crown, porcelain fused metal fixed (PFM) dental prosthesis to restore the masticatory function to improve the aesthetics.

Key words:

Calcium, Ceramic, Metabolic bone disease, 1,25-dihydroxyvitamin D, Enamel hypoplasia, 25-hydroxyvitamin D, Hypophosphataemic Rickets, Oral rehabilitation, Phosphate, Porcelain, Osteomalasia, Concordant approach, Rickets, Vitamin D-dependent rickets.

الخلاصة

تم في هذا الدراسة، والذي بعنوان مظاهر الأسنان في معمم نقص تنسج المينا ودور الكالسيوم بسبب نقص فيتامين د لدى مرضى الكساح ولين أو هشاشة العظام.

أهمية هذا الطيف من الأمراض و أثرها العام على صحة الفم و الأسنان من المرجح أن تزداد وكما الجزء من كبار السن من السكان يزيد في العقود المقبلة.

إن هؤلاء المرضى يعانون من التحسس الشديد للأسنان من البرودة والحرارة، وكذلك الشكل القبيح للأسنان بسبب اللون الأصفر وكذلك تسوس الأسنان مما سبب عدم استطاعة المرضى من استخدام الأسنان بشكل فعال أثناء الأكل.

قياس كمية الكالسيوم في مصل ٢٥ مريضاً وقد كانت النتيجة نقص نسبة الكالسيوم ومقدارها 8.33 ± 1.46 ملغم / ١٠٠ مل مقارنة بالمعدل الطبيعي 10.79 ± 2.19 ملغم / ١٠٠ مل.

لقد تم ترميم الأسنان لخمسة فقط من المرضى من خلال عمل جسور ثابتة مكونة من السيراميك والمعدن لأجل الحفاظ على الأسنان الأمامية المتبقية وإعادة شكلها و كذلك عمل تيجان معدنية للأسنان الخلفية من أجل أداء وظيفة الأسنان بشكل تام . إن إصلاح وإعادة تأهيل الأسنان لهؤلاء المرضى ووظيفيا وتجميلا لتقوية الحالة الشخصية والنفسية لهم.

Introduction

Rickets and osteomalasia is softening and weakness of the bones in childhood and adulthood, this can be caused by vitamin D and calcium deficiency as well as variety of metabolic bone disorders. Osteomalacia in adults and rickets in children are caused by inadequate mineralization of bone matrix. Vitamin D deficiency causes low calcium and phosphate, which lead to secondary hyperparathyroidism. Osteomalacia results from a loss of skeletal mass caused by inadequate mineralization of the normal osteoid tissue after the closure of the growth plates[1]. Rickets results from the same underlying process occurring in children and adolescents before the growth plates have closed. This is particularly important in adolescence when peak bone mass is achieved[2,3]. Rickets typically presents at 4–18 months of age in nutritional vitamin D deficiency. The clinical signs of calcium deficiency rickets occur up to 2 years later. Normal bone mineralization depends on adequate calcium and phosphate and this is maintained by vitamin D. Vitamin D is supplied either in the diet or produced from a precursor in the skin following exposure to ultraviolet light. Production of metabolically active vitamin D requires hydroxylation which occurs firstly in the liver and then in the kidneys to produce 1,25-dihydroxyvitamin D3. The recommended daily intake of vitamin D in the UK is 400 IU (10 micrograms) per day for an adult, 280 IU (7 micrograms) for children aged between 6 months and 3 years and 340 IU (8.5 micrograms) per day for infants under 6 months. These recommendations

only provide sufficient vitamin D to prevent osteomalacia and rickets[4].

Dental features of rickets include enamel hypoplasia and delayed tooth eruption due to failure of tooth mineralization [5,6]. These are more pronounced in hereditary forms[6] of rickets and may present as a feature of maternal vitamin D deficiency[7]. Sickly enamel with an increased susceptibility to plaque accumulation, caries and hypersensitivity to temperature changes [8]. This acquired disorder is known to be associated with the malfunction of enamel formation. Patients with vitamin D dependant rickets have severe enamel hypoplasia in the permanent teeth as in figure no.1.

Enamel hypoplasia is a defect in which the enamel of the teeth is hard and thin and deficient in amount as a result of defective enamel matrix formation with a shortage of the cementing substance. It is characterized by lack of contact between teeth, rapid breakdown of occlusal surfaces and a yellowish-brown stain that appears where the dentin is exposed. The condition affects both primary and secondary dentition. It is transmitted during the second half of pregnancy or during early tooth development[8].

A systemic condition during tooth development such as high fever, can produce a pattern of enamel defects in the dentition. The timing of tooth development permits estimates about the timing of the disturbance. The process of enamel maturation continues following tooth eruption so that erupted teeth can become less susceptible to decay over time. If the aberration in development is severe enough, it will result in soft enamel that chips and/or decays easily.

In hypoplasia, there is a lack of development or a defective development of the enamel of the tooth before its eruption. In deciduous teeth, enamel hypoplasia can be caused by a disturbance in the enamel formation before birth and, for some deciduous teeth, after birth. In permanent teeth, enamel hypoplasia can only be caused by some disturbance after birth since enamel formation of the permanent dentition begins at birth. Enamel prisms are deposited by the enamel organ in a definite pattern to form the crown of the tooth. A local disturbance as rickets interfered with this process and result in defective development. The degree of the hypoplasia varies from mild, shallow depressions or grooves to extensive grooves or pits arranged in horizontal rows around the crown. These grooves or pits extend into the enamel as far as the dentinoenamel junction. The defect may be a lack of development of all or part of the enamel, leaving exposed dentin[7].

Dental enamel is the epithelial-derived hard tissue covering the crowns of teeth. It is the most highly mineralized and hardest tissue in the body. Dental enamel is acellular and has no physiological means of repair outside of the protective and remineralization potential provided by

Materials and Methods

Blood samples were withdrawn from 25 patients (12 males and 13 females) for the period starting from march 2011 until the end of april 2012 and 15 blood samples (6 male and 9 female) were collected from healthy persons as a control group from hospital and private clinic in Al – Najaf city. Blood was drawn from the vein, usually from the inside of the elbow or the back of the hand without tourniquet. After withdrawing 3 ml of venous blood by a disposable sterilized

saliva. Enamel is comprised of highly organized hydroxyapatite crystals that form in a defined extracellular space, the contents of which are supplied and regulated by ameloblasts. When this occurs, it is important to remove the very soft enamel and to place a white tooth colored filling in that area. Occasionally, the aberration in the enamel is extensive enough that we may recommend a white crown as a temporary crown during the growing years. A large percentage of these teeth will be best served with a white crown after all your child's permanent teeth have erupted, growth is finished, and the occlusion has stabilized (age 18 or older)[8].

A recently published survey that reported the importance of treating those patients not only from a functional point, but from a psychological health also [9,10]. This dental abnormality poses a major restorative challenge for the dentist. Using conservative techniques desirable aesthetics can be achieved. Numerous treatment options have been described of the aesthetics and function, I documented many cases of generalized enamel hypoplasia and described the sequence of the concordant approach to restore the function and aesthetics to an acceptable level.

syringe (Tyco Health care), the blood transferred to plastic (Afma- dispo) anticoagulant free tube then left for several minutes to clot and centrifuged for 15 minutes at 1600 xg and then 1 ml of separated serum was isolated. A 0.01ml from this separated serum was used for calcium determination. A 25 patients (12 males and 13 females) with osteomalasia, were diagnosed by the x-ray to evaluate bone mass and fractures, who were between (15 - 35) age years, they had taken treatment, in comparison with the control at the same age also. They were come

complained from generalized yellowish teeth discoloration. They also complained of sensitivity to hot and cold, and compromised masticatory function.

They are very conscious about the appearance of their teeth because the primary dentition was affected in same manner. The medical history of the patients were complaining from rickets with vitamin D and calcium deficiency. This disease would be diagnosed in early childhood. They take 1 – alphacalcidol (0.5µg to 1µg/day) tablet as treatment till now. Serum calcium was determined using Ca kit purchased from Biomerieux / France.

Total calcium in sera was determined by a colorimetric method. Without deproteinization calcium ion reacts with the methylthymol blue indicator [MTB] in an alkaline medium. $\text{Ca} + \text{MTB} \rightarrow \text{Ca-MTB complex}$. The color intensity of the Ca-MTB complex, was measured at 612 nm, and it was proportional to the quantity of calcium present in the sample.

1-The spectrophotometer was prepared at the wavelength which was present in the calcium kit procedure. The wavelength was at visible line.

2- Ten µl of the sample that need to be measured was added to the working solution (1 volume of reagent 2 and 1 volume of reagent 3).

Statistical Analysis.

In this search the usual statistical methods were used in order to analyze and asses the obtained results.

Description statistics.

1-Statistical tables.

2- Arithmetic mean (X).

3-Standard deviation (SD).

4- Coefficient of variation (C.V %).

All the patients came were complaining from aesthetic problem because works, sensitive teeth and difficulties during eating.

Extra oral examination: normal

Intra oral examination:

Yellowish discoloration of entire dentition, missing teeth in different sites, caries in many teeth, teeth for root canal filling. Calculus in all teeth with gingivitis in upper & lower jaw and especially in posterior region. By clinical examination the patients were diagnosed as having a generalized enamel hypoplasia.

Five of them, were wanted a fixed dental prosthesis, two for upper jaw and one for lower jaw and 2 patients upper and lower jaw, so that dental work for them as the following:-

Maxillary and mandibular complete arch impressions were made using irreversible hydrocolloid (Tropicalgin; normal Set; Zhermack; Italy) impression material. Diagnostic casts were fabricated from type (Quayle Dental QD, England) dental stone and mounted in simple articulator and a centric relation record. The diagnostic waxing was done. The concordant approach was followed because of the complex needs of the patient. The treatment was aimed to improve esthetics, reduce the reported sensitivity of the teeth and restore the masticatory function.

Firstly; extraction of all retained roots which present, root canal filling for teeth needed that filling, filled the decayed teeth. Scaling and polishing was planned then fabrication of fixed dental prosthesis for restoration teeth in functional occlusion and esthetic rehabilitation of anterior teeth were planned. The patients were informed of the diagnosis and the treatment plan, which they accepted.

Secondly; oral prophylaxis was done and oral hygiene instructions were given, the patients were placed on 0.2 % chlorohexidine mouth wash twice daily.

Appropriate shade was then selected using the VITA shade guide(Vita Zahnfabrik,

Badsackingen, Germany) prior to preparation.

Teeth were for metal full ceramic restorations. Teeth were prepared for fixed dental prosthesis in maxilla, and mandible, impressions were made by polysiloxane (Condensation Silicone Zetaplus, Oranwash L, Indurent gel Catalyst for C- Silicone, Zhermack, Italy) impression material in special trays as in figure no.3.

From the impressions, casts were made and mounted in an articulator to produce two pieces in maxilla, one piece for mandible, PFM porcelain fused metal fixed dental prosthesis for covering the teeth and replacing the missing teeth, the metal frameworks were evaluated intraorally to determine the marginal fit prior to glazing of the ceramic, then the fixed dental prosthesis were completed in the laboratory and cemented with luting glass ionomer cement (AC, Dentsply, Germany).

The PFMs porcelain fused metal fixed dental prosthesis with previous full metal crowns were satisfactory both aesthetically and functionally at the end of six months of clinical continuation and the patients oral hygiene were satisfactory. Patients were very happy with their appearance, more confident during smile and highly ardent concerning with work as in figures no. 4, 5, 6, 7, 8, 9, 10.

Results

The result revealed that the changes which happened in the calcium levels in patients group is important, to explain that the most common causes of rickets and osteomalasia which are due to environmental vitamin D deficiency, from vitamin D deficient diet, and lack of sun light, or both. Over 90% of vitamin D is derived from ultraviolet B light and the rest is obtained from the diet.

Calcium absorption is central to the body's calcium, bone homeostasis and accounts for most of the variance on balance than does calcium intake. The absorption process comprises saturable, active and passive diffusion component [11]. On a conventional three meals a day regime, the maximum capacity of active process is about 400 mg a day but the loss of calcium into the intestine via the digestive juices 200 mg reduces the maximum active net calcium absorbed (the difference between diet and feces) to about 200 mg a day. Approximately 152mg is supplied by active transport and 48 mg by simple diffusion.

The calcium regulating hormones function like a fire bridge i.e when little calcium is being consumed, they are not activated that much, which is good, no fire. When too much calcium is consumed, the calcium hormones are very active, stimulating the absorption of calcium into the bones, and subsequently deportation and excretion. The more this processing is accelerated, the more bones are eroded. So after calcium is absorbed, calcitonin or thyrocalcitonin, inhibits deportation of calcium from the bones, while the calcium automatically keeps pouring in. Calcitonin also stimulates excretion of calcium through the urine. Calcitonin primarily lowers blood- calcium levels and absorption of calcium into the bones is one way to reach that aim.

Parathyroid hormone [PTH], stimulates uptake of calcium into the bone [12] and therefore osteoblast apoptosis [13] and deportation of calcium from the bones [14] and inhibition of calcium excretion, generally increasing a low blood calcium level. Logically, elevated PTH level accelerates ageing of the bones, low level of PTH prevent bone loss [15]. PTH also stimulates

secretion of calcitriol (1, 25 dihydroxycholecalciferol) vitamin D.

Table 1 Serum calcium in Osteomalasia patients and controls

Type group	Calcium in patients group					Calcium in controls group			
	Age year	N	Mean mg/dl	SD	CV%	N	Mean mg/dl	SD	CV%
Male	15-35	12	8.43	1.48	20.41	6	10.87	2.22	20.45
	15-35	13	8.18	1.36	19.62	9	10.72	2.22	20.70
Female	15-35	25	8.33	1.46	20	15	10.79	2.19	20.32
Total									

The results in table 1 explained the lower range of serum calcium in patients group 8.33 ± 1.46 mg/dl, even they still take the treatment, 1 – alphacalcidol according to the status of patients as a dose between (0.5µg to 1µg/ day tablet) in comparison with controls group 10.79 ± 2.19 mg /dl.

Discussion

Metabolic bone disorders often result in striking oral manifestations that can lead to a diagnosis of the underlying systemic condition. Numerous studies suggest that subclinical derangements in calcium homeostasis and bone metabolism may also contribute to alveolar ridge resorption and periodontal bone loss in predisposed individuals. The significance of this spectrum of diseases and their overall impact on oral health and dental management are likely to increase as the elderly segment of the population increases in the coming decades. A recent survey in the UK showed that more than 50% of the adult population have insufficient levels of vitamin D and that 16% have severe deficiency during winter and spring. The highest rates were found in Scotland, Northern England and

Northern Ireland[4]. In India, deficiency of vitamin D is the commonest cause of rickets and osteomalacia. These conditions are not caused by a dietary deficiency of calcium alone. Women seem to be affected more often because of multiple pregnancies and lactation that drain them of their calcium and vitamin D reserves. Both conditions can be diagnosed by demonstrable low plasma concentrations of calcium and 25 (OH)D .

Management of a patients with enamel hypoplasia is a challenge for the clinician. The restoration of aesthetics and function in these patients may be achieved with concordant approach. In our 5 cases, we must be take attention to detail, from diagnosis to post delivery monitoring, allowed a controlled and logical treatment sequence[16]. Based on the clinical presentation and medical history a diagnosis was enamel hyperplasia due to rickets, osteomalasia due to environmental vitamin D deficiency.

According to Seow [9] the primary clinical problem of amelogenesis imperfecta are aesthetics, dental sensitivity, and loss of vertical

dimension. These cases resemble to amelogenesis imperfecta are highly susceptible to dental caries, gingival inflammation.

The treatment options vary according to several factors such as age of the patients, socioeconomic status, periodontal condition, loss of tooth structure, severity of the disorder, and most importantly and the patient's cooperation[17].

There are number of alternatives for the treatment of anterior teeth affected by hypoplasia[18,19,20]. For many years the most predictable and durable aesthetic restoration of anterior teeth has been achieved with complete crowns[21]. However, as this approach requires the removal of substantial amounts of tooth structure, it is more invasive, but because we doing for this patient previous composite crowns in upper and lower teeth, so we do for those patients PFMs porcelain fused metal dental prosthesis, because the teeth prepared previously for crowns.

Traditional porcelain fused to metal (PFM) crown margins must be placed sub-gingivally because they are unattractive. Placing sub-gingival margins adds to the complexity of the crown procedure, one of the most challenging procedures in dentistry is the impression of a sub-gingival margin for a porcelain fused to metal PFM crown[22].

If we are discussing the benefits as compared to metal-supported crowns with overlying ceramic, there are many reasons as to the benefits of eliminating metal when placing crowns. One is the ability to be more conservative in tooth preparation. Most metal based crowns require 1.5-2.0 mm reduction. A second reason is "bondability" of many of the all-ceramic systems. We can utilize enamel and dentinal adhesion to increase resistance and retention form, which can be advantageous on teeth

with reduced clinical preparation height[23]. We could continue to use PFMs in patient who needs a full mouth reconstruction, and where aesthetics is just not the primary issue. Maybe the patient a bruxer and durability is an issue. We may have some chemical issues, erosion and things like that, also we could be used a PFM to replacing a very dark cast post and very dark tooth. It is difficult to fully block out a very dark tooth with an all-ceramic crown.

In contrast the popularity of porcelain laminate veneers has increased since being introduced because tooth preparation is conservative, and the restorations are aesthetic[24]. In addition, patient acceptance of porcelain veneers has been shown to be high in clinical studies[25]. The percentage of patients completely satisfied with porcelain veneers varied from 80% to 100 % [26].

In my cases, a concordant approach as PFM covers the entire teeth. The teeth previously prepared and the patients were simply bruxer, with slightly dark teeth, so I use PFM porcelain fused metal fixed dental prosthesis.

The clinician has to consider the long term prognosis of the treatment outcome. The clinical reported describes the fabrication of full metal crowns for the restoration of posterior teeth in functional occlusion, and porcelain fused metal fixed dental prosthesis for anterior teeth as a restorative approach to modify teeth color, shape and length and to close the space. Patients with these defect must be continuo the maintenance of oral hygiene.

The importance of treating these cases is not only from functional aspect, but also from psychosocial health aspect. The difficulty of the management of patients with enamel

defect needs a careful considerations of patient expectations, this approach with successful outcome and patient satisfaction.

Conclusion

This clinical research described a rickets, osteomalasia develops when low dietary calcium intake coexists with a low or borderline vitamin D nutrition status. concordant approach for generalized enamel hypoplasia with use of porcelain fused metal fixed dental prosthesis for upper and lower jaws, full metal crowns for posterior teeth to restore the masticatory function, improve the aesthetics and to reduce the reported sensitivity of the teeth with careful consideration of patient expectations and requests as in figure no. 11.

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Figure 1 Generalized Enamel Hypoplasia