



Role of Vitamin D on muscle tonicity amongst edentulous

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Abstract-

It is well known fact that complete edentulism causes a deficiency of multiple macro and micronutrients. Vitamin D is one of the important micronutrients which needs to be evaluated in such patients. This study was done to evaluate role of micronutrient Vitamin D on the muscle function and muscle tonicity through serum estimations, ultrasonography, electromyography and questioner-based analysis before and after therapy. Materials and Method: An interventional study was conducted at Dr Z.A Dental College AMU Aligarh and was supported by ICMR. A total of 130 patients without any teeth aged between 40-70 years were selected for the research and on the basis of serum Vitamin D levels were categorized into groups A & B. Group A (Control group) and Group B (Supplemented with Vitamin D drug): Patients were given Complete dentures of both group and were evaluated using EMG & USG. Results- Vitamin D quantities varied from 9.5 to 38.5 ng/ml in the concerned samples. At enrolment, only 3 (2.3%) had vitamin D sufficiency while the majority (71.5%) had vitamin D deficiency. No significant association of vitamin D levels was observed with age and dietary preference. Mean USG measured in MM thickness showed a significant decreasing trend with maximum value in vitamin D sufficient cases (9.53 ± 0.25 mm) and minimum value in very severe vitamin D deficient cases (5.15 ± 0.80 mm) ($p < 0.001$). Conclusion- The present study considered the hypothesis that edentulism leads to micronutrient deficiency regardless of age, sex, or food practises.

Main Text-

Introduction:

It has been documented that complete edentulism causes a deficiency of multiple macro and micronutrients. Giving an artificial set of teeth can help patients in restoring general health by replenishing macro-nutrients. Still, the deficiency of micronutrients prevails. Therefore, the main objective of this research was to evaluate the role of nutrition in muscle wasting amongst completely edentulous patients. In order to restore the degenerated oral tissues amongst the completely edentulous patients, the role of the micronutrients i.e. Vitamin D is evaluated on the muscle function and muscle tonicity through serum estimations, ultrasonography, electromyography and questioner based analysis before and after therapy.

Materials and Method:

An interventional study was conducted at Dr Z.A Dental College AMU Aligarh and was supported by ICMR. A total of 130 patients without any teeth aged between 40-70 years were selected for the research and on the basis of serum Vitamin D levels were categorized into groups A & B. All the edentulous patients got complete dentures fabricated for both maxillary and mandibular arches.

1) **Group A** (Control group): Edentulous patients are given complete denture prostheses for both arches. Patients of this group were not given any micro-nutrient but were instructed to intake a healthy nutritious diet. All patients were evaluated EMG & USG.

2) **Group B** (Supplemented with Vitamin D drug): Edentulous patients are given complete denture prostheses for both arches. Patients of this group were given Vitamin D drug as a micro-nutrient and also were instructed to intake a healthy nutritious diet. All patients were evaluated for EMG & USG.

Inclusion criteria: Recall method for Vitamin D estimation i.e. dietary intake of Vitamin D, exposure to Sunlight, duration & amount of area exposed, skin complexion & equatorial location of the country will be considered. Patients aged between 40-60 yrs. Both genders of patients were included. Post-menopausal females were considered. Not severely resorbed ridges i.e. in OPG, bone height should be a minimum 10-15mm. Completely edentulous for not more than 6 months were preferred. Both vegetarians and non-vegetarians.

Exclusion criteria: Any systemic disorders or any immune drug therapy. Very weak personality patients. and thin patients. Missing teeth because of any accident, traumatic injury involving soft tissue injury or fracture of the bone. History of any drug allergy.

Sample selection: The selection of samples is on the basis of a Randomized Control Trial. The completely edentulous patients coming to the OPD of the Department of Prosthodontics, Dr Z A Dental College, AMU, Aligarh; are selected on the basis of inclusion and exclusion criteria mentioned in the protocol. Only the Monday OPD patients are chosen for free fabrication of the complete denture prosthesis in this study. We have completed the Complete Denture fabrication of 130 denture patients with the administration of the drug Vitamin D in 127 patients.

Methodology: Once the patient is diagnosed with a completely edentulous state, he is advised for a complete denture (C.D.) as a prosthesis required for chewing food, improving aesthetics and better phonetics. If the patient agrees to C.D. fabrication as a treatment of choice, he is explained in detail about this project on Vitamin D and a written consent is made signed. Starting with the initial steps including primary and secondary impressions, jaw –relation is recorded within a week. And, all three investigations viz Ultrasonography (USG), Electromyography (EMG) and Serum Vitamin D are evaluated at level ‘0’ i.e. before starting any procedure or therapy. USG values are obtained by averaging the thickness of the masseter muscle (MM) at the level of maximum thickness. EMG is done using surface electrodes. The patient is asked to bite over the occlusal rims/occlusal bites fabricated by us. Levels of serum Vitamin D are evaluated further by an endocrinologist (one of our co-investigators), and according to the prescription Vitamin D administration is started. Since a maximum of the patients are found to be Vitamin D deficient, we administered an Oral dosage of Vitamin D with 60,000 IU. Calcium supplementation is generally recommended with Vitamin D intake. Considering the literature and endocrinologist recommendations, patients with serum Vit D levels above $>30\text{ng/mL}$ were not given any Vitamin D dosage, considered to be in the control group; with D3 insufficiency patients ($21\text{-}30\text{ng/mL}$), we administered oral dose with 60,000 IU monthly for six months with lukewarm milk. With D3 deficiency ($11\text{-}20\text{ng/mL}$) they were given an oral dose weekly for three months and an oral dose of 60K IU monthly for another three months, with lukewarm milk. Lastly, patients with severe D3 deficiency ($1\text{-}10\text{ng/mL}$) were given 60,000 IU dosage orally biweekly for one month, later weekly for two months, and lastly 60K IU monthly for the last three months. To maintain the patients’ compliance, we recalled patients every Tuesday and Saturday, for drug administration by ourselves. Vitamin D was administered with lukewarm milk. Post-operative recordings of all three investigations were done. After completing three months course of Vitamin D for each patient, USG, EMG and Serum levels of Vitamin D were evaluated again. On completing 3 months drug regime, patients were recalled monthly for three consecutive months, for the maintenance phase. Now, again the investigations were done to evaluate the results. Therefore, in this research the investigations have been done at 0-, 3- and 6-month intervals. Questionnaire-based evaluation of every patient is also done after three months of the treatment. Final complete denture fabrication and insertion are done at the end of three months of treatment. Post-operative instructions were given, and they were recalled for post-operative follow-up, which included complete denture adjustments if required.

Results and Discussion:

Statistical Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 21.0. ANOVA, paired ‘t’-test Spearman coefficient was used to compare the data. A ‘p-value less than 0.05 indicated a statistically significant. The present study was carried out with the aim to evaluate the relationship between vitamin D quantities and masticatory muscular efficiency and to measure whether vitamin D supplement helps in improving the masticatory muscular efficiency of mature edentulous adults. For this purpose, a prospective interventional study was done, in which a total of 130 patients falling in the sampling frame were enrolled.

According to the geographical profile of patients enrolled in the study. The age of patients ranged from 40 to 70 years. A maximum number of patients were shopkeepers/service personnel (37.7%) followed by farmers/unskilled labourers (36.2%), housewives (20.8%), skilled labourers (3.8%) and professionals (1.5%) respectively. A total of 68 (52.3%) had sun exposure. The majority were rural (54.6%) residents. Vitamin D quantities varied from 9.5 to 38.5 ng/ml in the concerned samples. At enrolment, only 3 (2.3%) had vitamin D sufficiency while the majority (71.5%) had vitamin D deficiency. No significant association of vitamin D levels was observed with age and dietary preference. However, males as compared to females, farmers/unskilled labourers as compared to other occupations, those having sun exposure as compared to those not having sun exposure, rural as compared to urban and those having a history of denture use as compared to those not using denture had significantly higher levels of vitamin D.

Table 1: Association between Vitamin D status and masticatory musculature efficiency at enrolment

SN	Vitamin D status	No. of cases	USG		EMG	
			Mean	SD	Mean	SD
1.	Sufficiency	3	9.53	0.25	316.67	11.55
2.	Insufficiency	24	7.43	1.00	203.08	40.15
3.	Deficiency	93	6.34	1.13	138.62	34.40
4.	Very severe deficiency	10	5.15	0.80	92.20	14.80
Statistical Significance (ANOVA)			F=19.789; p<0.001		F=55.629; p<0.001	
Bivariate correlation (“r”)			r=0.612		r=0.778	

At enrolment, USG evaluation showed MM thickness in 4.0 to 11.8 range with a mean of 6.53 ± 1.29 mm. At EMG, values ranged from 71 to 330 units with a mean of 151.1 ± 51.7 units. Mean USG measured in MM thickness showed a significant decreasing trend with maximum value in vitamin D sufficient cases (9.53 ± 0.25 mm) and minimum value in very severe vitamin D deficient cases (5.15 ± 0.80 mm) ($p < 0.001$). There was a positive influence between vitamin D levels and USG-measured MM thickness. Similar to the MM thickness, EMG data also revealed a significant decreasing trend with maximum value in vitamin D sufficient cases

(316.67 ± 11.55) followed by insufficient (203.08 ± 40.15), deficient (138.62 ± 34.40) and very severe deficient cases (92.20 ± 14.80) ($p < 0.001$). (Table-1).

Post-Intervention Outcomes-At 3 months: Between enrolment and three months follow-up, there was an increase in vitamin D from 16.06 ± 5.62 ng/ml to 38.51 ± 10.84 ng/ml thus showing an increase of 17.45 ± 10.80 ng/ml (108.66% rise). Statistically, this change was significant ($p < 0.001$). USG measured MM thickness showed an increase from 6.53 ± 1.29 mm to 7.39 ± 1.21 mm thus showing an increase of 0.86 ± 0.49 mm (13.2% rise). Statistically, this change was significant ($p < 0.001$). EMG values showed an increase from 151.1 ± 51.7 to 223.5 ± 52.97 thus showing an increase of 72.4 ± 44.38 (47.9% rise). Statistically, this change was significant ($p < 0.001$). At 6 months, Between 3 months and 6 months, there were four follow-up losses. Hence the final assessment could be done in 126 cases.

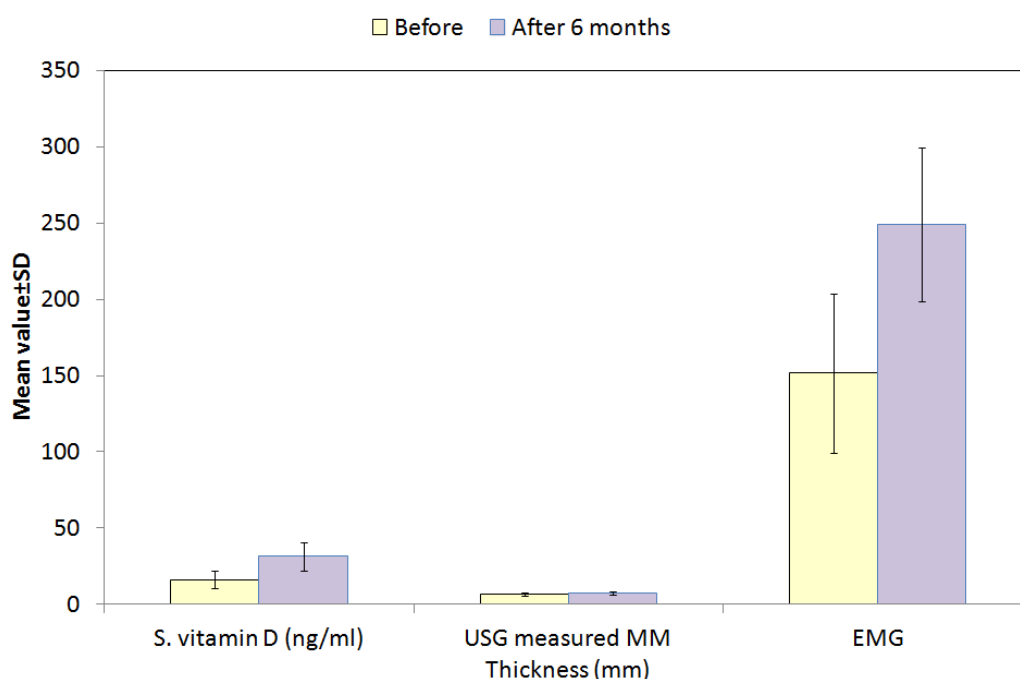


Fig. 1: Change in vitamin D, USG measured MM thickness and EMG values at six months

At 6 months, vitamin D quantities varied from 12.0 to 60.5 ng/ml. Majority (60.3%) were vitamin D sufficient followed by those having vitamin D insufficiency ($n=40$; 31.7%) and deficiency ($n=10$; 7.9%) respectively. At 6 months after the intervention, no patients was found with extreme deficiency of vitamin D. Mean vitamin D levels at 6 months were found to be 31.35 ± 9.28 ng/ml.

Mean USG measured MM thickness showed a significant decreasing trend with maximum value in vitamin D sufficient cases (7.83 ± 0.96 mm) and minimum value in severe vitamin D deficient cases (6.03 ± 1.06 mm) ($p < 0.001$). There was a mild positive correlation between vitamin D levels and USG-measured MM thickness ($r=0.416$). Likewise, MM thickness, EMG values also showed a significant decreasing trend with maximum value in vitamin D sufficient cases (267.67 ± 36.43) followed by insufficient (233.80 ± 48.99) and deficient cases (169.80 ± 45.30) ($p < 0.001$). There was a moderate positive correlation between vitamin D levels and EMG values ($r=0.585$).

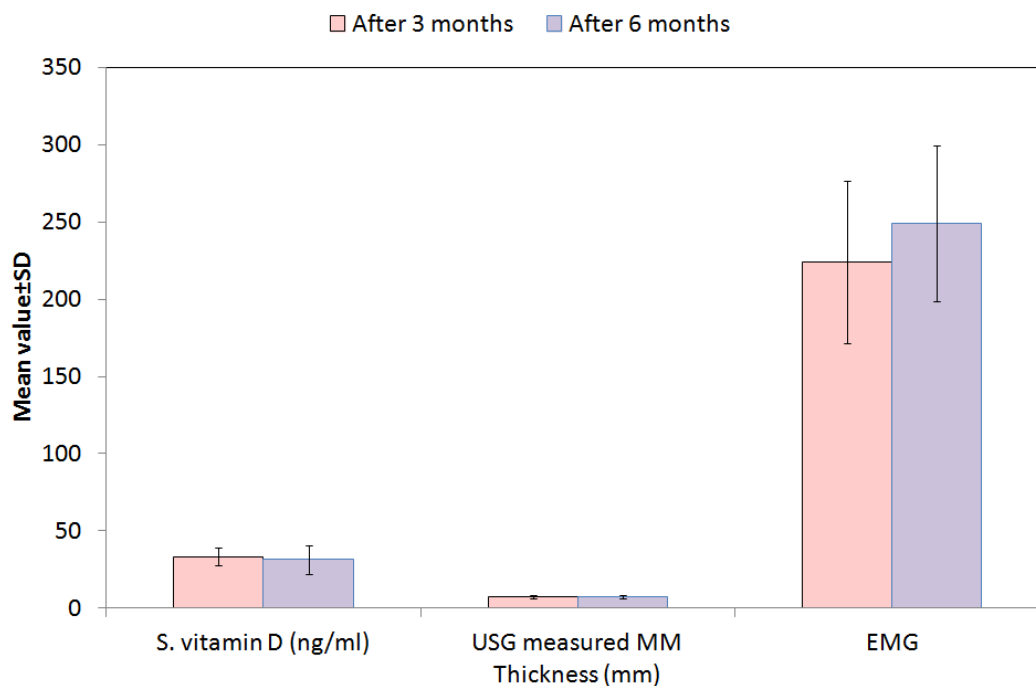


Fig. 2: Change in vitamin D, USG measured MM thickness and EMG values between 3 and 6 months

Although mean vitamin D levels showed a significant decline during 3 to 6 months period (5.97% reduction) ($p < 0.001$), however, both MM thickness, as well as EMG values, exhibited a substantial rise throughout the period ($p < 0.001$), thus representing the enhanced efficiency of mastication following the intervention of vitamin D.

The questionnaire results showed that 1-highly satisfied (19 pts); 2-satisfied (73 pts) ; 3-cannot differentiate (17) ; 4-not satisfied (10), 5- was poorly retained (9).

Conclusions

In the state of edentulism, with the set of artificial teeth, it becomes very tough to disintegrate the food bolus into very smaller components, which can result in poor absorption of all macro as well as micronutrients. The absorption of macronutrients (like- protein, vitamins, Carbohydrates etc) could occur through the major bolus, but the problem arises with the micronutrient absorption process. Resulting in micronutrient deficiency which can cause various deteriorating alterations in the physiology of the body and associated tissues, thus causing the subject weak and fragile in due course of time. Therefore, the present study considered the hypothesis that edentulism leads to micronutrient deficiency regardless of age, sex, or food practises, was proven correct. Furthermore, it was also concluded that Vitamin D should be considered as one of the important micro-nutrients, for which therapy should be planned in geriatric patients especially those who are dependent on RCDs for mastication and speech. The scope of the study says, like Vitamin D is proven as one of the important micro-nutrient of diet, the study also ascertained the fact that regular systemic assessment of various micronutrients should be done for healthy physiology and it should be emphasised at a broad scale. Also, additional research is recommended with long-term evaluation to determine the effect of the micronutrients on edentulous subjects.

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