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Evaluation of Salivary Nickel and Chromium Level of Iraqi Sample Treated with Fixed Orthodontic Appliances

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Abstract

As orthodontic appliances consider one of the esthetic treatment in dentistry, which contain variable amount of Nickel and Chromium in different part of the orthodontic appliance that may release in saliva and affect patient's health, the aim of the study was conducted to evaluate the nickel and chrome concentration level in saliva for orthodontic patients who are treated with nitinol and stainless steel arch wire and compare this concentration with that of control group. Three groups have been studied 1st group and 2nd experimental includes 17 patients with nitinol arch wire and other 17 patients with stainless steel arch wire. The 3rd group was control group includes 17 patients without orthodontic appliance, stimulated saliva collected in sterile screw capped bottle, and kept at (-20 C°) then allowed to defrost at room temperature, then the concentration of salivary ions of nickel and chromium was measured by using atomic absorption spectrophotometer. Descriptive and Inferential statistical analysis has been used. Revealed significant difference in Cr and Ni concentration among three groups. This study proved that with nitinol arch wire the level of Cr and Ni increase in saliva more than that of control and stainless steel group.

Introduction:

Brackets, arch wires, molar tube and bands, are the main components of fixed orthodontic appliance treatment which contain different amount of chromium (Cr) and nickel (Ni) , stainless –steel metal used in orthodontic appliance contain 18% Cr and 8% Ni while nickel titanium wires contain 50% Ni [1]. Many studies revealed the toxic, carcinogenic and allergic effect of these ions [2, 3]. Additionally, exposure to free radical of Ni can cause liver and kidney damage [4]. Population may be exposed to nickel in different place and at different level as in ambient air, food, water, cigarette smoking and contact with jewelry and coin that contain Ni alloy. Cr also can be found in food, drinking water and air, so know their level is important in human body as it affect human health [6, 7]. The oral environment make a good situation for degradation of alloy (Ni and Cr) found in orthodontic appliance as thermal, corrosion and enzymatic properties all enhance this degradation [8].

In vitro, several studies demonstrated the release of Ni and Cr ions from brackets, but this test is limited to clinical situation because it cannot reach the complex and dynamic oral environment [9, 16, 17]. Salivary analysis is the most reliable measurement since it is the first diluent of human body and allow long period of analysis [10] .It show that Ni and Cr level increase in saliva & serum after insertion of fixed orthodontic appliance [3]. Many studies showed that no cytotoxic level produced with orthodontic appliance [5, 19, 25], so the arch wire containing Ni and Cr have been used widely know a day. The aim of this study is to evaluate the nickel and chrome concentration level in saliva for orthodontic patients who are treated with nitinol and stainless steel arch wire and compare these concentrations with that of control group.

Materials and Methods:

This study was conducted in the Immamain Alkadhemain Medical City,patients attended this center seeking for orthodontic treatment were involved in this study. The sample composed of 51 patients aged 15 to 30 years old, divided into 3groups,1st experimental group includes 17 patients (7 males and 10 females) those patients whose orthodontic appliance of nitinol arch wire and the 2nd experimental group includes 17 patients (4 males and 13 females) with stainless steel orthodontic appliance. The 3rd group (control group) includes 17 patients (5 males and 12 females) without orthodontic appliance. Patients with nitinol arch wire wear the appliance from (3 – 12) months while those patients with stainless steel arch wire wear the appliance for long period from (12 - 24) months.

The criteria of the patient's inclusion:

1. Healthy patients with no history of any medical problems and none smoker.
2. Patients have no metallic crown, bridge or any palatal or lingual bar.
3. Patients wear Roth bracket with 22-slot bonded on all of the teeth with molar bands.

Sociodynamic data wear taken from each patients including age, gender, smoking, duration of the treatment.

Saliva collection, storage and processing

Stimulated saliva was collected from all individuals included in this study, before saliva collections, asked the patients to chew a piece of sugar free gum for one minute to stimulating saliva secretion and then asked to remove all saliva by expectoration. Chewing was continued for 10 minute then saliva was collected in sterile screw capped bottle. The patients must be advised not to eat or drink one hour before saliva collection, and should n't be under stress and sit in relaxed position during collection of sample [13]. Samples were kept at (-20 C˚) until they were processed. Prior to determination the salivary samples were allowed to defrost at room temperature, concentration of salivary ions of nickel and chromium was measured by using atomic absorption spectrophotometer.

Ethical consideration

The approval of ethical and scientific unites of research in Al Iraqia Dental College was taken. Agreement of health authority of Al-karkh health directorate was approved and verbal consent of all patient were obtained before starting the study.

Statistical analysis

Data were interred into personal computer. SPSS version 22 soft wear was used for statistical analysis. Descriptive statistic was present in form of frequency, percentage, means, and standard deviation. Table and figures were used to illustrate data. Inferential statistic was presented in form of, one way ANOVA, after application of SHAPIRO test to confirm the normality of distribution of measured numerical variable, with P-value less than 0.05 for significant differences.

Results:

The results of this study illustrated in Table (1) shows the difference between mean of patients age for different

treatment groups that show non-significant differences between them. In Table (2) shows the difference in Cr concentration among three groups (control, nitinol arch wire and stainless steel arch wire) that the mean of nitinol group (0.047 µg/dl) higher than stainless steel group (0.027 µg/dl) and control group (0.015 µg/dl) using ANOVA test, it found that the difference was highly significant among the means of these three groups. (P value ≤ 0.001). Table (3) shows the difference in Ni concentration between three groups. That the means of nitinol arch wire(0.32 µg/dl) and stainless arch wire (0.32 µg/dl) were found the same value , at same time were higher than mean for control(0.19 µg/dl), statistically these show significant difference. (P value < 0.001).

Discussion

It is known that orthodontic appliance have different type of metallic ions which can be release into the oral cavity [11,12] by corrosion and this will affect by many factors like manufacture process [10] environmental factors such as mechanical stress, dietary intake, the flow rate of saliva, plaque brushing and the healthy state of individual [13]. These ions may lead to sensitivity or even allergic stomatitis and in some cases mutagenic effect [14, 15]. In vitro study has been conducted to know the ions release in artificial saliva and mouth wash [16, 17], but these study were simple and quick and did not reflect the accurate situation of the oral cavity. In this study, it was attempted to evaluate the amount of Ni and Cr ions in patients with fixed orthodontic appliances after prolong treatment period and if these ions may reach toxic level or not. The general population may be exposed to Cr and Ni daily through food, drinking water and air also may be expose to these ions through inhalation of cigarette smoke[6] ,this might explain the presence of these ions in control group in spite they did not wear any appliances. Ni can be found in black tea, nuts, seed, spinach, banana, bear and chocolate …..etc., while Cr can be found in food like tomato, oats, lettuce, black pepper[18] in in addition these ions can be found naturally in jewelry, coins, keys, cellphone….etc. and make all population expose to it. The higher significant difference in the level of Cr and Ni in both experimental groups (nitinol and stainless steel group) compared with control group probably due to corrosion of metal in oral cavity and low PH. This result agree with finding of both Talec et al [19] and Neamach [13,] who concluded that presence of orthodontic appliances lead to increase concentration of metallic ions in salivary secretion even after short period of insertions, while Aziz et al [8] found increase of the ions after immersion period of the appliance in artificial saliva.This study has been carried out (3- 12) months for nitinol arch wire and (12-24) months stainless steel arch wires, this periods can give the appliances enough time to dissolute inside the oral cavity depending on Fors &Persson [20] who took 16 months as study period, also Ağaoğlu et al [3] who showed that an increase of Cr and Ni ions level after one year of the appliance insertion. And this result disagrees with other studies Eliades et al [21] and Gjerdet et al [5] who did not detect any increase of ions in saliva of patients with orthodontic appliances. Barrett et al [22] found that the release of Ni and Cr ions from orthodontic appliances of both nitinol and stainless steel was not significantly different, which resemble the finding of this study in only Ni concentration which shows non-significant difference between experimental groups, while Cr shows significant difference between nitinol and stainless steel arch wire. This variation may be due to type of appliances, size of arch wire, duration of the treatment, diet or due to short cross-sectional study. Longitudinal study would eliminate or explain these differences and give good relation between treatment period and ions release. According to WHO the recommended dose of was (Ni 25-35) µg/day and Cr (50-200) µg/day and the amount of ions release in this study did not exceed the recommended dose and this result agree with many studies [16, 17, 23, 24]. Ağaoğlu [3] and Bengliel et al [25] stated that the concentration of ions release in saliva did not reach toxic level during

treatment period. Other studies [26, 27] explained that any allergic to nickel appear was disappear after 2 day to several months and it recommended to use nickel free appliance for such a case. The release of metal ions cannot be avoided and it might cause hypersensitivity to oral mucosa, mild redness or erythema and may be conjugated to poor oral hygiene [29]. To identify the accurate ions level further study are suggested to examining blood or urine samples for those like patients and knowing the systemic effect of these ions.

Conclusion

This study proved that:

1. With niti arch wire the level of Cr will increase in saliva more than stainless steel and control group.
2. With niti arch wire the level of Ni will increase in saliva of experimental groups more than that found in control group.

Table (1): One way ANOVA for age group.

	No.	Mean age (years)	Std. Dev	Min	Max	Sig
Control	17	22.47	1.84	20.	26.	0.074
Niti arch wire	17	20.05	2.81	16.	25.	
Stainless steel arch wire	17	22.23	4.63	15.	30.	
Total	51	21.58	3.41	15.	30.	

Table (2): Mean of Chrome in saliva of different groups.

	Mean	Std. Dev.	Sig	Pair wise comparison		
				1&2	1&3	2&3
1.Control	.015	.003	F 29.39 df 2,48,50 P value <0.001	S	S	S
2.Niti arch wire	.047	.019				
3.Stainless steel arch wire	.027	.006				

*S=significant difference

Table (3): Mean of Nickel in saliva of different groups.

	Mean	Std. Dev.	Sig	Pair wise comparison		
				1&2	1&3	2&3
1.Control	.019	.003	F 20.03 df 2,48,50 P value <0.001	S	S	N S
2.Niti arch wire	.032	.005				
3.Stainless steel arch wire	.032	.010				

*S=significant difference
**NS=No significant difference

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