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A comparative study between the atomic absorption and spectrophotometric method in the assessment of the corrosion

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ABSTRACT

Back ground: Atomic absorption method is the most accurate method in the assessment for the determination of corrosion of dental alloy. The spectrophotometric method with the use of chromogenic complex was used also in the assessment of the corrosion. The aim of this study was to compare between the two methods.

Material and Methods: twenty amalgam specimens were used: each was stored in 5 ml of normal saline solution for 1 month. The specimens were randomly grouped into two groups (group A and group B). Then the assessment of the corrosion was done by measuring of the released mercury, for group A is done by the atomic absorption method and for group B by the spectrophotometric method.

Result: there is no statistical significant difference between two methods.

Conclusion: the spectrophotometric method was successful alternative method to the atomic absorption methods in the assessment of the corrosion.

Key ward: corrosion , mercury, atomic absorption ,spectrophotometer.

الخلاصة

مقدمة :-تعتبر طريقة الامتصاص الذري الطيفي من أفضل الطرق وأدقها وأكثرها صحة في قياس مدى تآكل المعادن المستخدمة في طب الأسنان .

قدمت الطريقة الطيفية مع استخدام مركبات معقدة ملونة وحساسة خاصة ايضا لقياس التاكل حيث انها طريقة اسرع واقل تعقيداً . يهدف هذا البحث لاجراء مقارنة بين الطريقتين.

المواد والطرق: اخذت عشرون عينة من كبسولات حشوات الاملغم ، وضعت بعد تحضيرها في 5مل من السائل الفسيولوجي الطبيعي وحفظت لمدة شهر في حاضنة بدرجة 37 درجة مئوية ، ثم قسمت عشوائيا الى قسمين : قسم أ وقسم ب تم قياس الزئبق المطروح في سائل الحفظ لعينات القسم أ بطريقة الامتصاص الذري اما القسم ب فقد تم القياس بطريقة الطيف مع المعقد الملون.

النتيجة: لا فرق بين نتائج الطريقتين.

الاستنتاج: طريقة القراءة الطيفية يمكن ان نعتبرها بديلا ناجحا لطريقة الامتصاص الذري في قراءة تآكل المعادن.

Introduction:

The method of measurement is very important aspect in the analytic chemistry. The atomic absorption method had been used to determine the qualitative and quantitative analysis of the metal ions present in a specific solution after immersion (1).

The analysis of atomic absorption considers as one of spectral method to estimate the quantity of element or group of elements which depend upon absorption of the resonance radiation of that element by its cloud of neutral free atoms. If the atomic cloud passes within any molecular forces and subjected to radiating energy with a wave length equal to energy required to transmit the atom from ground state level of the low energy through its outer electrons to the excited state level which has very high energy, but this electrons are no longer stay there and quickly they descend down with very high speed to the ground state level. These electrons loss the energy absorbed in the term of spectral form with the same level, which has the same properties with the atom of elements this spectral form, is called resonance radiation (2).

Many investigators used this technique in studying the corrosion behavior of dental amalgam by measuring the concentration of the Hg ions released from the amalgam specimen in different electrolyte medium for various period of time (1,2,3,4,5,6).

Burne studied the initial corrosion of amalgam into artificial saliva, the initial mercury release from such specimens could exceed the long term mercury release form old amalgam (1).

George Palaghias used the atomic absorption method in the assessment of the corrosion by the measurement of the released mercury and he had been shown that the low pH will enhance the corrosion (7).

The spectrophotometric method with the using of a new highly sensitive chromogenic reagents was used in detection and measuring of the concentration of the ions. Azo compound have attracted much attentions they are chromogenic reagent and play a vital role in analytical chemistry due to highly sensitive colour reaction and stability towards various metal ion. Azo dyes have N=N group which makes them more reactive toward various metal . These compounds form water-insoluble complexes with the metal ions , therefore ; there complexes are either dissolved in water or extracted in a suitable solvent for there spectrophotometric determination , which tedious and time consuming so more simpler and more rapid method was introduced based on the reaction of the mercury with HADMP(5-[4-hydroxy phenyl azo]-4,6-dihydroxy-2-mercaptopyrimidine) (8,9).

Hemed et al were use the spectrophotometric method in the measuring of the released mercury from the high copper and low copper amalgam and showed more mercury release from the low copper than the high copper dental amalgam (10).

The aim of this study was to compare between the two methods (atomic absorption and spectrophotometer method) in the measurement of the concentration of the mercury ions as an indicator for the corrosion.

Material and Methods:

Twenty precapsulated amalgam specimens (SDI , low copper , Australia) were used in this study . After the mechanical amalgamaction (according to the manufactural instruction) each amalgam mass was stored separately in a sealed glass tube containing 5 ml of normal saline solution. All the samples were stored in incubator for 1 month at 37c°.

Then the samples were randomly grouped into two group A and group B (10 samples for each).

For group A: the released mercury in the solution was measured by using of the atomic absorption machine (2004-Japan),(11),Fig 1.

Fig 1 :Atomic absorption machine

The released mercury of group B samples was measured by using the spectrophotometer with the chromogenic complex. All spectral and absorbance measurements were carried out on a Shimadzu UV-visible 1700 double beam spectrometer (Inlob WTK, Germany) using 1 cm glass cells. A digital pH meter was used.

All the chemicals used were of analytical reagent (AR) grads. Distilled water was used throughout the present study. 5-[4-hydroxy phenyl azo]-4,6-dihydroxy-2- mercaptopyrimidine [HADMP] (1×10^{-3}) M. 0.066 g of reagent was dissolved in 250 ml of ethanol. Working of (HADMP) 5×10^{-5} M solution was prepared by simple dilution of the appropriate volume of the (HADMP) solution with ethanol.

Standard Hg solution (1 $mg.ml^{-1}$). was prepared by dissolving 0.268 g of HgCl2 in 200 ml distilled water, working standard of Hg solution were prepared by simple dilution of the appropriate volume of the standard Hg solution (1000) ppm with distilled water.

Analytical Procedure (12):

In to a series of five calibrated flask , transfer increasing volumes of Hg working solution 20 µg.ml-1 to cover the range of the calibration curve , add 2.5 ml of 5×10^{-5} M of HADMP solution and pH was adjusted at five calibrated flask by 0.05 M of HCl and 0.05 M of NaOH.

The complex formed was solubilized in water and diluted up to five ml with distilled water and allow the reaction mixture to stand for five min. at room temperature. Measure the absorbance at 585.0(nm) for Hg complex against a reagent blank prepared in the same way but containing but not containing Hg. The color of the complexes is stable for 24 hrs. (12).

Result:

The descriptive statistics (the numbers of the samples , means values, standard deviation and student t – test) are calculated and represented in table (1) and represented in bar chart of Fig. 2.

Student t – test was used to compare between the concentration of the released mercury (corrosion) in atomic absorption and spectrophotometric method, which reviled no statistical significant differences at 0.5 p value

Table 1: The descriptive statistics

Con. Of Hg ***µg /ml***	**No.**	**mean**	**SD**	**T. test**	**P value**	**Sig.**
Group A	10	0.0210	0.00948	-.541	0.5	Non.sig
Group B	10	0.0228	0.00454			

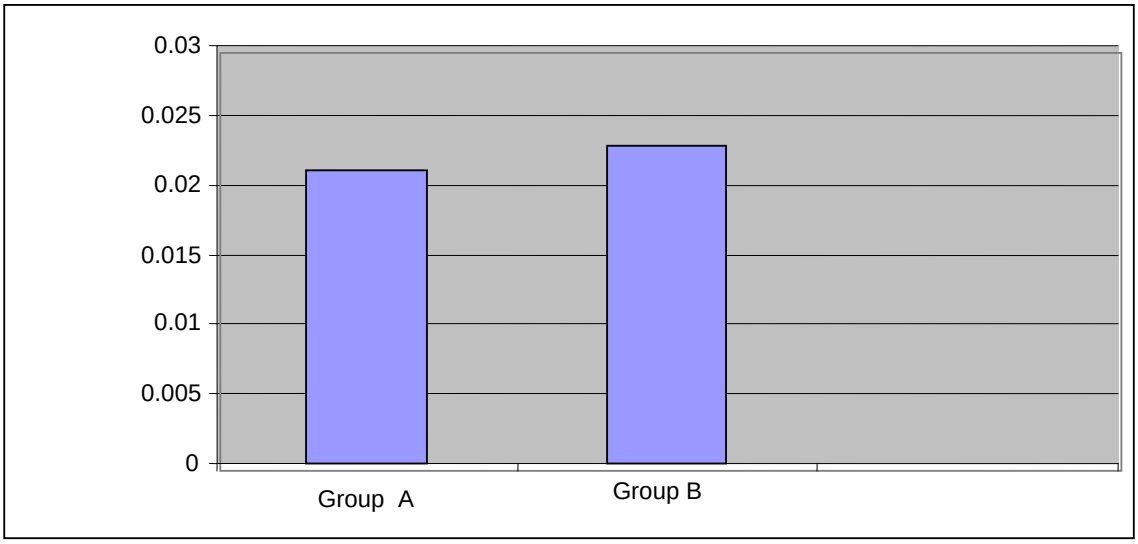

Fig 2 :Bar chart of the mean value of the released mercury in atomic absorption method (group A) and spectrophotometric method (group B)

Discussion:

Atomic absorption method was used for studying and analyzing the corrosion behavior of different metals in term of concentration of the ions of the metals released in different solutions .The atomic absorption instrument give quantitative measurement that can be calculated and compared statistically. (1,2).

The spectrophotometric method with chromogenic reagent was introduced as accurate sensitive more simple method for the measurement of the released ions in a solution . In the studying of the corrosion behavior the measurement of the released mercury was used as an indicator for the corrosion of the dental amalgam, which give an indication for the toxicity of the dental amalgam (10,12,13).

Dental amalgam result from trituration of proper quantities of silver based alloy and mercury .Approximately half of the set amalgam consist of mercury particularly all of which bound in gamma 1 and gamma 2 phase (14,15) ;so the mercury ion was used to make the comparison between the tow methods.

In this study the tow methods (atomic absorption method and the spectrophotometric method with the specific chromogenic reagent) were compared with the use of SDI amalgam alloy in term of concentration of mercury ions in normal saline solution at a temperature of 37c for 1 month period of time.

Group A: showed the measurement of the released mercury which coincide with the many authors were they used the atomic absorption method in detection of the mercury (1, 2,3,4,5,6).

Group B: showed the ability of the spectrophotometric method with the chromogenic complex in detection and quantitative measuring of the released mercury; which coincide with the Hemed et al (10).

The result of this study reviled that there is no statistical significant differences between the measurements of the released mercury in either the atomic absorption or spectrophotometric methods.

Conclusion:

This study introduce the spectrophotometric method with the chromogenic reagent as an alternative to the atomic absorption methods in the measuring and the assessment of the corrosion of any metal or any released ions in any solutions.

References:

1- Burne D.: Corrosion of amalgam,Scan.Jour. Dent.Res,84,506-514 ,1981.
2- Abdulrhman M S, Acomparative study to assess corrosion behavior of Iraqi amalgam alloy , Master thesis submitted to the College of Dentistry University of Baghdad, (1999).
3- Derand T &Johanson B.:Corrosion of non gamma two amalgams,Scan.Jour.Dent.Res,91,55-60.,1983.
4- Derand T.:Test for long term corrosion of dental amalgam, Scan.Jour.Dent.Res,94,253-258,1986.
5- Patsurakos A.& Moberg L.B., Corrosion behavior and micro hardness of three amalgams, Scan.Jour.Dent.Res. .,96,376-383, 1986.
6- Moberg L.B., corrosion of dental amalgam and mercury vapor emission, Scan.Jour.Dent.Res,96,473-477, 1988.
7- Palaghias G .,The significance of pH for the inhibiting effect of phosphate buffer on the corrosion process, Acta Odonto.Scan., 43,289-293 ,1985.
8- M. Abed Al-Rudha, H.J. Mohammed: Synthesis, Sperctrophotometric determination of Hg(II) using new azo dye 5-[2-hydroxy phenyl azo]-4,6-dihydroxy-2-mercaptopyridine. J. Kerbala Univ., 5, 4 ,51 ,2007.
9- SH. Al. ALbderee,Determination of cd(II) and Hg(II) spectrophotometerically by using new derivative of azo. Master thesis submitted to the College of Education, University of Kufa, (2007).
10- Hemed S.J. Mohammed ,H.,J. : Measuring the released mercury spectrophotometrically(New chemical approach),Kufa Medical J.13, 1s :39-44,2010.
11- Burtis C.A.,Ashwood E.R., Bruns D.E.:Tietz textbook of clinical chemistry and molecular diagnostics ,SaundersCompany,USA.:73-75 ,4rth ,2006.
12- A Wahadneh E alhidawi I Kheresat K Emad E Alhaija :Amalgam and it s potential toxicity Jordan Dent.J, 11 ,1 :19-26 ,1996
13- MAndel I. O. Amalgam hazard. an assessment of research. J Am Dent Assoc ,122 : 62-65, 1991.
14- Grag R.G.,with contribution of Asgar k., A very J.K.,Dennison G.B.,Koran A., Myers G.E.,O Brien W.J.,Peyon F.Power J.M.,Restorative dental materials ,Amalgam, 10th edition:ch.9,1996.
15- Burne D. &Evje D.M., Initial corrosion of amalgam in vitro,Scan.Jour.Dent.Res.,92:165-171, ,1984.