Fluoride release from Iraqi made glass ionomer cement. A comparative study

Jabbar H KAMEL*
Faraed D SALMAN**
Mohammad S AL-AJELY***

ABSTRACT

This study was carried out to determine the fluoride release from Iraqi and two imported glass ionomer cements by placing (15) specimens (five for each type of glass ionomer cement) in a polyethylene container filled with deionized water and TISAB. Measurements of fluoride release were taken daily for (8) days following specimen preparation followed by once weekly for a month. Mean daily fluoride release was plotted against time. The results showed that there was a significant difference between Iraqi and Hibond materials within the same period of fluoride release and no significant difference between Iraqi and Degussa cements.

The Iraqi glass ionomer cement showed sufficient fluoride release.

Key Words: Glass ionomer cement, fluoride release, Hibond cement, Degussa cement.

الخلاصة

أجريَت هذه الدراسة لقياس كمية الفلور المتحررة من ثلاثة أنواع من سمنت الكلاس أيونومير (نـوع عراقي ونوعين مستوردة) بوضع (١٥) نموذج (خمسة لكل نوع من أنواع السمنت) في وعاء من مادة البولي أثيلين مملوء بماء مقطر منزوع الأيونات مع حامض النتريك. تم قياس كمية الفلور المتحـررة يوميـاً لمـدة ثمانية أيام بعد تحضير النموذج متبوعاً بقياس أسبوعي لمدة شهر، ثم أحتُسِب المعدل اليومي للفلور المتحـرر مع الوقت.

أظهرت النتائج أن هناك فرقاً معنوياً بين السمنت العراقي وسمنت (Hibond) لنفس الفترة لتحريـر الفلور وليس هناك فرق معنوي بين السمنت العراقي و سمنت (Degussa) الألماني المنشأ.

لقد أظهر السمنت العراقي تحرير للفلور بصورة كافية.

INTRODUCTION

It is known that the incorporation of fluoride into the enamel structure as fluorapatitic [$Ca_5(PO_4)_3F$] can result into remineralization of small decalcified or carious lesions and also reduce the formation of new lesion [1], as well as rendering the enamel less susceptible to acid dissolution by oral bacteria [2].

The clinical advantages of fluoride as an anticariogenic agent have been well documented and have prompted the inclusion of fluoride into a host of dental materials [3]. Furthermore, cariostatic potential has been shown to be related to the magnitude of fluoride release and not merely to the fluoride content of a resin [4].

* Jabbar Hussain KAMEL; BDS, MDSc; Prof. Department of Conservative Dentistry, College of Dentistry, University of Mosul, Mosul, IRAQ.
** Faraed Daoud SALMAN; BDS, MSc : Asistant Lecturer. Department of Pedodontics, Orthodontics, and Preventive Dentistry, College of Dentistry, University of Mosul, Mosul, IRAQ.
*** Mohammad Salman AL-AJELY; BSc, MSc, PhD; Prof. Department of Chemistry, College of Education, University of Mosul, Mosul, IRAQ.

Rawls [5] referred to glass ionomer cement as the modern version of silicates. Indeed, glass ionomer cements combine the durability and inherent fluoride releasing capability of silicates with the advantages of a polyacrylic acid, namely adhesion and biocompatibility [6]. The greatest release has been found to occur during the first day [7], and the release continues even 2 years later, although at a decreased rate [8].

More recently, an Iraqi made conventional glass ionomer cement [9] based on acid base reaction had been introduced alternative to imported cements to break the unfair embargo on Iraq.

The purpose of this *in vitro* study was to determine the fluoride release from Iraqi glass and two imported glass ionomer cements.

MATERIALS AND METHODS

Fifteen specimens were made in disk shaped with a diameter of (10) mm and thickness of (2.5) mm. Five samples for Iraqi made glass ionomer cement and five for each of the imported cements, namely Hybond (SHOFU INC) and Degussa.

The disk was fabricated in stainless steel ring and suspended by stainless steel wire. Each specimen was placed in a polyethylene container filled with (3) ml of deionized water and incubated at (37) C°. Measurement of fluoride release was taken daily for (8) days following specimen preparation. TISAB (Total Ionic Strength Adjusting Buffer) was added at (10%) (v/v) to the distilled water. This created a constant background ionic strength for fluoride measurement [10].

The released fluoride was then measured using radiometer AIS EMDRUPVE J 72 DK–2400 Copenhagen NN Denmark with F 1052 fluoride ion sensitive electrode.

Data were obtained and recorded in part per million (ppm) for each disk of the materials. Measurements were made at 24–hours interval for the first (7) days, followed by once weekly for a month. The sample solution was changed (24) hours before analysis to prevent the measurement from being cumulative.

The measurements were used to determine an average daily fluoride release from each specimen during those weeks. Mean daily fluoride release was plotted against time.

RESULTS

The fluoride release from each glass ionomer cement during (30) days was illustrated in figures (1), (2) and (3).

The initial fluoride release decreased with time; the greatest release occurred over the first (24) to (48) hours. There was no significant difference in release of fluoride among Iraqi and Degussa cements over the initial first week period, while significant difference was obtained between Iraqi and Hybond material within the same period of fluoride release.

The fluoride release after the first (10) days fluctuated between (2.5–13) ppm, (0.9–1.8) ppm and (0.3–0.6) ppm for Hybond, Iraqi and Degussa cements respectively.

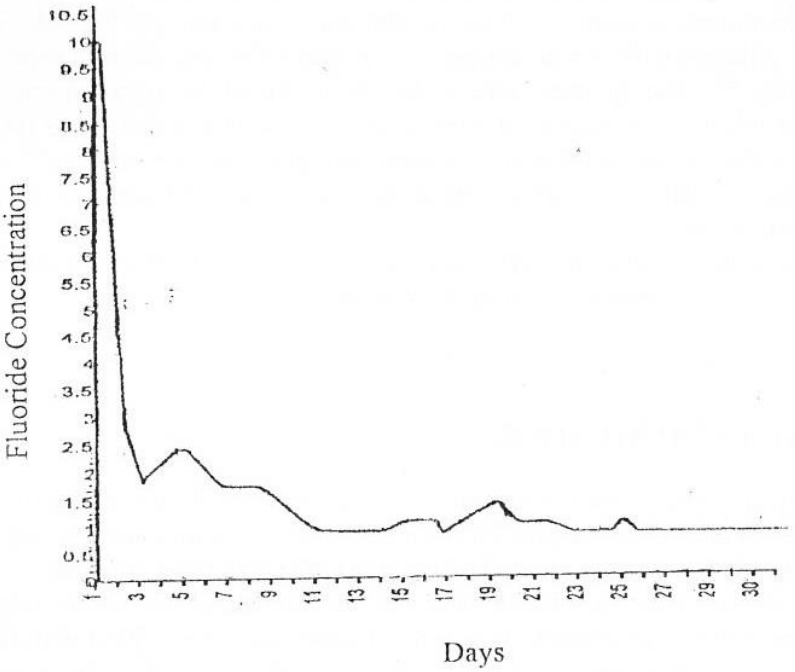

Figure (1): Fluoride release from Iraqi made glass ionomer cement

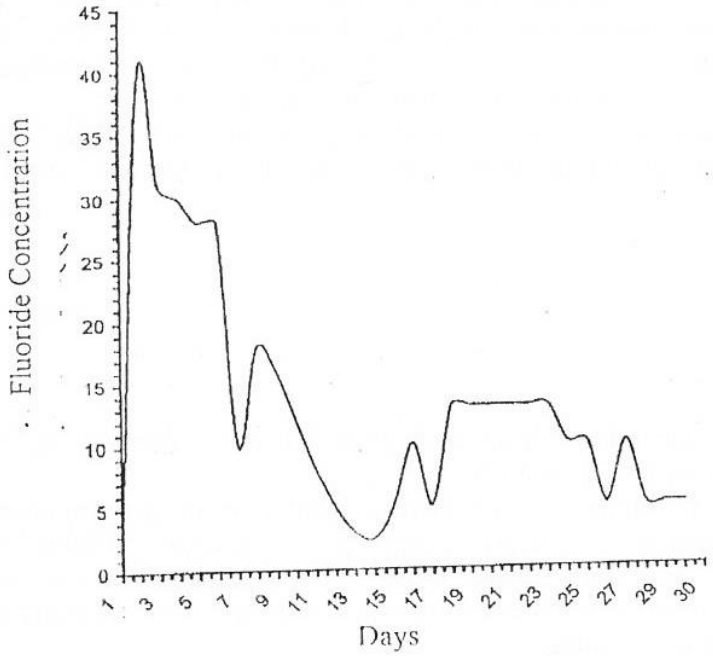

Figure (2): Fluoride release from Hibond glass ionomer cement

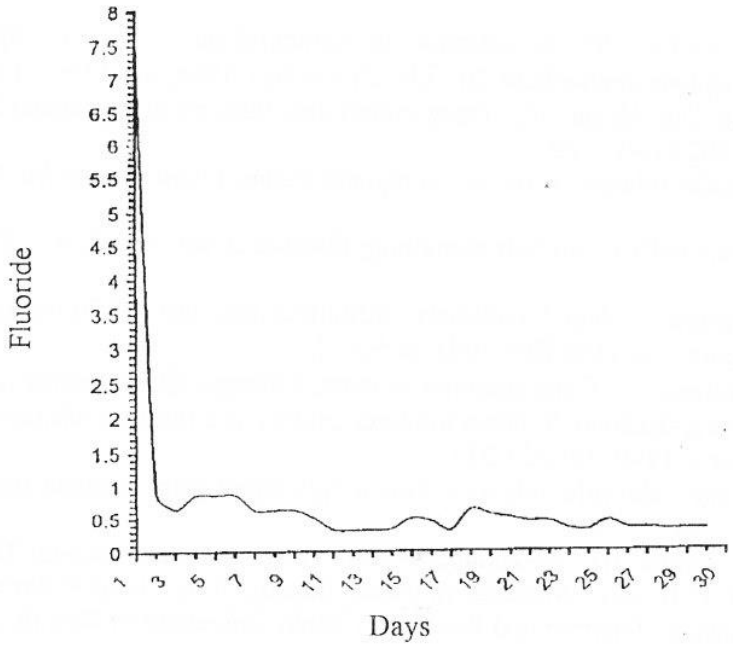

Figure (3): Fluoride release from Degussa glass ionomer cement

DISCUSSION

The fluoride release for conventional glass ionomer cements has been attributed to acid base setting reactions involving fluoride containing glasses and a polyacid liquid [11], leading to fluoride liberation. This results in the large surge of ion release in the first days as the material sets and the majority of glass species react.

The general trend for fluoride release for the three glass ionomer cements over the course of (30) days was downward. This is a common finding with the glass ionomer cements. However, one month study revealed that fluoride release of Iraqi glass ionomer cement does not reach zero, a low relatively stable level of ion release was reached.

The question arises as to whether the amount of fluoride released by glass ionomer cement is sufficient. In this context, it was recently reported that with a fluoride release of as little as (0.2) μg F/cm^2, a fluoride uptake in the outer (10) mm of enamel after (24) hours contact of as high as (5400) ppm occur [12]. Therefore, the Iraqi glass ionomer cement showed a sufficient fluoride release for clinical application, and the low dose, slow release of fluoride from the cement appear to be promising vehicle to increase fluoride around restorations.

CONCLUSION

Released fluoride was measured daily with ion sensitive electrodes for an Iraqi made glass ionomer cement and two imported glass cements. The highest concentrations of fluoride were released during the first few days. Concentration gradually diminished to nearly constant level.

The Iraqi glass ionomer cement showed sufficient fluoride release.

REFERENCES

1. Mellberg JR, Mallon DE. Acceleration of remineralization *in vitro* by sodium monofluorophosphate and sodium fluoride. *J Dent Res.* 1984; 63: 1130-1135.
2. Priest ND, Van Der Vyver FL. Trace Metals and Fluoride in Bones and Teeth. 1st Edn. Boston. CRC Press. 1990.
3. Swift EJ. Fluoride release from two composite resins. *Quintessence Int.* 1989; 20: 895-897.
4. Phillips RW. Restorative materials containing fluoride. *J Am Dent Assoc.* 1988; 116: 762-763.
5. Rawls HR. Preventive dental materials: Sustained delivery of fluoride and other therapeutic agents. *Adv Dent Res.* 1991; 5: 50-55.
6. Wilson AD, McLean JW. Glass Ionomer Cement. Chicago: Quintessence. 1998.
7. Koch G, Hatibović–Kofman S. Glass ionomer cement as a fluoride release system *in vivo*. *Swed Dent J.* 1990; 14: 267-273.
8. Mitra SB. *In vitro* fluoride releases from a light cured glass ionomer liner/base. *J Dent Res.* 1991; 70: 75-78.
9. Al–Ajely MS, Kamel JH, Al–Hamdany AA. Glass ionomer cement. The Fourth Conference of Polymeric Material Science, Basrah, Iraq. Iraqi Polymer Society, College of Science, Polymer and Research Center, University of Basrah. Abstract 2 & 3 Nov. 1999.
10. Moody GJ, Thomas JFR. Ion Selective Electrodes in Analytical Chemistry. 2nd Edn. Henery Freizer, New York. Ch 10. Pp: 369-370.
11. Smith DC. Composition and characteristics of glass ionomer cement. *J Am Dent Assoc.* 1990; 120: 20-22.
12. Tanbirojn D, Retief OH, Russel CM. Enamel cementum and dentin fluoride uptake from a fluoride releasing composite. *Am J Oper Dent.* 1992; 5: 226-232.