GLASS IONOMER CEMENT ON CLINICAL PRACTICE: A STUDY REVIEW

Cimento ionômero de vidro na prática clínica: revisão da literatura

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RESUMO

Há mais de 40 anos o cimento ionômero de vidro vem sendo introduzido na Odontologia e desde então sua fórmula inicial tem passado por modificações na tentativa de melhorar os produtos utilizados pelos Cirurgiões Dentistas, favorecendo as condições bucais da população mundial com o propósito de desenvolver novos materiais e técnicas restauradoras. A presente pesquisa teve por objetivo atualizar os odontólogos acerca dos novos conceitos e tendências do cimento ionômero de vidro na prática clínica. Foi realizada uma revisão integrativa baseada na literatura onde as publicações foram selecionadas a partir de uma pesquisa nas seguintes bases de dados: pubmed, ebsco e bireme, aplicando os seguintes termos de busca: cimentos dentários; cimentos de ionômeros de vidro; material dentário; uso terapêutico, compreendendo o período de 2001 a 2014. Já existe conhecimento considerável acerca do cimento ionômero de vidro e apesar da sua constante utilização nos consultórios odontológicos ainda existe a necessidade de mais conhecimento e aprimoramento técnico por parte dos profissionais para que se possa gerar resultados satisfatórios a longo prazo.

Descritores: cimentos dentários; cimentos de ionômeros de vidro; material dentário; uso terapêutico

ABSTRACT

For over 40 years, the glass ionomer cement has been utilized in dentistry. Since then it has undergone modifications in an attempt to improve the products used by oral and dental surgeons, and to improve oral conditions favoring the world's population in order to develop new materials and restorative techniques. The aimed of this present study was to update the dentists about new concepts and trends of glass ionomer cement in clinical practice. An integrative literature review was performed and publications were selected from a search in the following databases was: PUBMED, EBSCO, AND BIREME applying the following search terms: glass ionomer cements and dental materials, comprising the period from 2001 to 2014. There already exists considerable knowledge about the glass ionomer cement and despite its continual use in dental offices; there is still a need for more knowledge and technical improvement by professionals so that we can generate satisfactory long-term outcomes.

Key words: dental cements; glass ionomer cements; dental material; therapeutic use

INTRODUCTION

The glass ionomer cement is a material based on an association of two cements, the silicate glass powder and the zinc polycarboxylate. This association combines the best properties of these two restorative compounds to suppress the needs of modern dentistry, which aims for the development of new materials and new restorative techniques. The biocompatibility, the adhesion to the dental structure, and the ability to release fluoride make this material unique and demanding in Dentistry, especially on the Pediatric field.

The Restorative Dentistry aims an evolutionary standard that fulfills three bases: biocompatibility, resistance and esthetics. The biocompatibility of the material is related to the dental adhesion, which provides a better incorporation of the material with the dental tissue. The resistance includes the anti-cavity properties that prevent tooth decay, as well as the achievement of quality in the restoration, that should be able to resist the oral environment. Finally, the esthetics is a requirement of many patients[1,2].

It is important to highlight that since its discovery, the glass ionomer cement has been the target of many researchers, and it has evolved to an extremely versatile material[3-7].

Due to this evolution of glass ionomer cement, a large number of materials were included in its formula. There is not product that is chemically and mechanically equal to this cement[8-10].

Daily, dentists face several clinical issues, and have to choose the dental material wisely. The glass ionomer cement has an important role in the dentistry practice; therefore, it is essential that the dentists are familiar with recent studies, so that they can be aware of the right technique, the indication, the contraindication, and it´s properties. The aim of this review study was to update the dentists on the new concepts and trends of glass ionomer cements on the clinical practice.

METHOD

To conduct this review study, a cautious research was performed based on the following database: PUBMED (23), EBSCO (05) e BIREME (07). The key words used were “glass ionomer cement” and “dental materials”. The reason why just this two search terms were used is that they were related to the theme and were part

of the key words of Ciências da Saúde site (http://decs.bvs.br).

The articles included presented methodological quality, had external validity, and a little or none bias. Articles containing overlay were excluded.

Three Criteria were established to narrow down the results: the timing of the studies (defined between the years of 2001 and 2014), the language (Portuguese, English and Spanish) and the methodology applied.

TYPES OF GLASS IONOMER CEMENT

Glass ionomer cement cementing

According to Lad et al.[11] the glass ionomer cement cementing type functions are fulfill the emptiness on the interface of dental restorations, block the restoration so there will be no displacement during the chewing, and connect orthodontic devices or crowns. The cementing type can be considered as definitive (long-term) or provisory (short-term). The glass ionomer cement cementing type has a thinner granulation of the powder, which gives the mixture a better fluidity. Thus, those cements chemically bond to the dental structure; and since it is compatible with the oral environment, they are easy to remove, in case of excesses. Furthermore, its properties also include low viscosity and excellent flowing. When compared to the other types of cement, this resists better to compression than the lining glass ionomer cement that is worse restoration type. However, as a disadvantage, it is the glass ionomer cement with the longest setting time[10,12].

This kind of glass ionomer cement is most indicated to cementing of chromed steel crowns and orthodontic bands. It is the best choice material for orthodontics, independently if it is the conventional or the resin modified[13]. That is due to its excellent adhesion to the dental structure and to its fluoride release, which is a property that both glass ionomer cement own[11].

In a systematic study review, the efficacy of the glass ionomer cement adhesive systems fixing orthodontic bands on teeth during the orthodontic treatment was evaluated. The conclusion was that the efficacy was not enough to it could be considered the best material for this propose. However, an advantage of the glass ionomer cement is the capacity of fluoride release and the good

relationship between the tooth enamel and the unoxidized steel [13].

Glass ionomer cement restorative

Nowadays the patients require more esthetic restoration and less invasive procedures[14]. Because of that, the glass ionomer cement used in dentistry has grown and it is an extremely helpful material on Dental Care[12].

On previous studies, the metal or the resin hybrid of glass ionomer cement were denominated as the best materials for restorations. For instance, resin modified glass ionomer cement or silver modified glass ionomer cement have a better resistance to chewing forces[10,11,15].

The restorative glass ionomer cement is a high-density cement; therefore, both its solubility and its setting time (about 6 minutes) are low. In addition, its final resistance (after 24 hours) and dentine adhesion are higher than the other types of glass ionomer cements[11,16].

The conventional glass ionomer cement is mentioned on literature only for its use on provisory restorations on complex cavities, because it is low resistance to loss and cohesion, which limits the use of it on areas where there are chewing forces[13]. However, this material is very useful on cavities and on low-tension areas such as the cervical and front faces[17].

The conventional glass ionomer cement is indicated for restorations class I, II, III, e V. The resin modified glass ionomer cement is most indicated for class II of small and medium extension. On the other hand, class III cavities present a better prognostic when the conventional glass ionomer cement is used. That is due to its fluoride release, which is essential on the contact point. The conventional glass ionomer cement is also indicated to restorations class V, because it increases the duration of these restorations. This kind of cement is widely used on the Atraumatic Restorative Treatment technique and also on restorations class II, because it preserves the marginal anatomy and avoids the loss of healthy tissue adjacent to the cavity lesion[1,13].

Glass ionomer cement lining

This material were the first ionomeric material ever to be used. The goal was to use it as a base of restorations, due to its good sealing[10]. Furthermore, it also offers protection to the dentine reminiscent. Its working time is the smallest, and its solubility the higher, when compared to the other

cements. However, this material also have its advantages: the smallest dentinal adhesion and the smallest tension resistance when compared to the other types of cement. Currently, it is still considered the best material to line for amalgam and composite resin restorations[15].

The use of glass ionomer cement lining associated with composite resin is a good alternative because it allows the dentist to diminish the quantity of Composite Resin[18], minimizing the polimerization contraction, which creates an interface that is acid resistant because of the ions fluor release[13]. However, the conventional glass ionomer cement is also associated with Composite Resin restorations. The Composite Resin adhesion to the conventional glass ionomer cement is due to the mechanical interlock between the adhesive agent and the micro retentions produced on the cement surface, when the acid conditioning is being accomplished[4,12].

A correct protection of the complex dentine-pulp is required to avoid chemical, physical and biological injuries to the pulp tissue[14]. Several factors may interfere on the lining fitting, such as regional variation, dentine humidity, bubble´s incorporation, and the effect of the polymerization contraction tension, especially when the lining material is inserted in a single block[19].

Cardozo et al.[19] claims the need of more research to find better physical characteristics of the lining materials, such as the development of effective mechanisms of adhesion to the dentine, reduction of the volumetric contraction, and the accomplish of researches that evaluate the adhesion behavior of this material, regarding low contraction resins.

Technical Applications

França et al.[5] conducted a systematic review to inform the professionals about the glass ionomer cement uses, highlighting the aspects of these materials. They used articles written between the years 2000 and 2008, and selected them on the database Medline, Brazilian References of Odontology and Scopus. The authors verified that thirty-five of the articles (74.5%) used the conventional technique according to the fabricators orientations, whereas twelve articles (25.5%) used it with modifications on the application, so both of the results could be compared. The conclusion was that the glass ionomer cement reach better results with the

conventional technique, even though there was a good outcome of the modified techniques of glass ionomer cement.

The glass ionomer cements are quite sensitive to dosage and manipulation, and the mechanical properties are related to following the exact recommendations of the manufacturer. The right amount of powder and liquid are crucial to obtain the best proprieties of the material; therefore, any modification on the proportion powder-liquid could result in higher solubility, smallest resistance and smaller adhesion[9,8].

The cavity´s surface must be clean, so the ionic exchange can occur during the use of glass ionomer cement. In order to this cleaning occur, it is recommended the application of polyacrylic acid at 10% for 10 seconds, followed by rinsing it with water. However, it is important to observe the contamination of water and dehydration, so that the application can occur without concerns[1,20].

The ability of the operator is also one of the glass ionomer cement limitations, since the mixture, the exemption of the material, and the surface protection could lead to mechanical properties issues if it is not preceded as the manufacturer recommendation. To eliminate this limitation, there is a system of pre-dosed capsules on the market. These capsules reduce the working time and offer an easiness on manipulation. In order to prepare the capsuled materials, it is necessary to break the capsule, activate it with a capsules amalgamator, during 8 seconds, and apply it in the cavity with the insertion spatula, or with injector tips. This new shape of glass ionomer cement already comes with the right proportion powder/liquid; therefore, it has a lower risk of bubbles formation on the manipulating process, which makes this material less propitious to operator´s errors. However, the cost is higher than the other shapes[1,15,20-21].

The glass ionomer cement is a material susceptible to syneresis and imbibition, during 4-8 minutes, consequently the restoration needs surface protection that can be done with varnish, adhesive system or Vaseline. This procedure avoids water evaporation that is ionic bonded to the adjacent chains that are being formed. Leite et al.[22], corroborating with this idea, evaluated the fluoride ions absorption on Glass Ionomer Cement, and the outcome was that the Vaseline was the best surface protector, followed by varnish and finish gloss (surface

protector of the product VITREMER of brand 3M ESPE).

Scientific Evidences on Clinical Practice

Over the years, the glass ionomer cements have been studied, because it´s great efficiency and use on the dental clinics. Researches try to update the dentists as for applications and product evolution, as well as comparative data of the material´s efficiency when tested in vitro or in vivo.

No material is perfect. The advantages and disadvantages should be considered when it comes to choose a certain material. The professional should be based on knowledge of the available materials, the type of restoration, the esthetical demands of the patient, and the clinical practice of this professional[11].

Azevedo et al.[13] applied a questionnaire to evaluate the knowledge of 60 dentistry students of a dental school in the south of Brazil. The results were interesting: all the students already had used this material as lining for cavities; 83.3% already had used the material as a provisory restoration after an endodontics treatment, and 73.3% already had used it as a permanent restoration on deciduous teeth. Referring to the clinical technique used, 86.7% inserted the material when it was still shining, 33% finished and polished the restoration on the next session, and only 28.3% declared that applied a surface protection immediately after the restoration is finished. The conclusion was that the students seemed to be familiarized with the types, proprieties, uses and techniques of the glass ionomer cements. However, sometimes the students do not follow some of the clinical procedures. Thus, the properties of these materials as well as the treatments' results can be affected[13].

Based on that, Costa et al.[14], a bibliography review about glass ionomer cement's resistance. The period of the selected articles was between 1995 and 2010. The total of articles selected was 23. The authors identified as essential variables for the success of this material: the material's composition, the time between the insertion and the end of restoration, and the selected technique. The results showed that compared to the conventional cements, the resin modified cements had better properties. In addition, there is a need for an adhesive system self-

conditioning on glass ionomer cements, to increase the mechanical resistance of it.

There are many types of glass ionomer cements; therefore, the professionals must be aware of the different manufacturer instructions. According to Sidhu[15], there will always be differences between the products, as well as differences on its efficacies. Thus, the operator should always be concerned about the clinical application of this product, so the aimed results can be reached.

One of the recent version of the glass ionomer cement is the encapsulated that is an improvement on the technical difficulties, because it already comes with the right proportion of powder/liquid. Molina et al.[23] on a study about the mechanical performance of the restorations, observed the results of this cement using the Atraumatic Restorative Treatment technique. In this study, 240 test bodies of 6 mm of diameter and 3mm of height were used to the flexion test, and 80 test bodies were used for the diametral traction. All the pieces were prepared as a model of restoration class II on teeth. The ANOVA and Turkey test were used. The testing systems for the study group (encapsuled) were EQUIA, and CHEMFIL ROCK; and for the control group (conventional ionomers), the testing systems were GOLD LABEL FUJI 9, AND KETAC MOLAR EASYMIX. The outcome was that the study group had significantly higher values to the diametric traction, flexion and compression resistance than the control group.

The glass ionomer cement anticavity effect is also discussed on literature to fissure sealing. Yengopal et al. did a meta-analysis in 2009 with the aim to compare this effect with resin sealing. In this study, the resin sealing had an efficiency 4 times bigger than glass ionomer cement concerning the cavity prevention after 5 years. However, the author also discussed the contrast of this data with current literature, as well as the need for more quality studies.

It is interesting that on the next year, Yengopal and Mickenautsch[6] did a study review of clinical tests, and the conclusions were that compared to resin sealing; there is no evidence of the higher anti-cavity effect of glass ionomer cement for a period of 2 years. However, due to the low quality of the current clinical tests, these conclusions must be reviewed. Mickenautsch[24] also concluded in his

review the need for more evidency on this anti-cavity effect.

To compare the anti-microbal activity of three glass ionomer cements, using the Calcium hydroxide paste as a control group (Vidrion R, Ketac Molar, Meron R e Biocal), Bengtson et al.[2] verified that the Vidrion R (9.26±0.79) and the Ketac Molar (8.96±0,56) had no statistical different between themselves ($p>0.05$). However, between all other material combinations, there was statistical differences ($p<0.05$).The Meron R cement (12.33±2.06) presented higher inhibition halos, and the Biocal (5.59±0.76) presented the smallest. For that matter, a mixed culture of the biofilm of four patients were used in a diffusion test with Agar blood. The materials shaped in test bodies were accommodated in circle excavations in the middle of the culture, where were the solutions of the bacterial cultures. The inhibition halos were measured in a millimeter scale and the results were submitted to ANOVA, and Turkey test ($p<0.05$).

It is known that the anti-cavity effect is due to the fluoride release, the essential quality of a glass ionomer cement. It is also known that glass ionomer cement can receive a fluoride recharge to aid on this recharge more efficiently. Leite[22] did a study to evaluate the absorption of these fluoride ions on glass ionomer cement of mechanical and manual manipulation within one single topic application of fluoride. The conclusions were that those had similar abilities to attract the ions, when submitted to a single topic application of Sodium Fluoride at 2%.

Bruyne and Moor[3] did a survey concerning the glass ionomer cements. They related that due to the glass ionomer cement´s ability to relate to the dental tissues, specially the dentine, as well as the fluoride release, this material is excellent for restoring dentistry and to endodontics, especially to the sealing of radicular roots.

To compare this anti-cavity effect, Rastelli et al.[25], performed a retrospective study in 160-fissure sealing, made on 119 patients. Hundred twenty-six of the sealing was done with glass ionomer cement and 35 with flow resin. Results indicated that both products were efficient to maintain the dental surfaces free of cavities, even when lost partially or totally.

A study was made to evaluate the superficial roughness of the glass ionomer cements indicated to ART.

Silva and Zuanon[8] selected four types: Fuji IX, Ketac Molar, Vidrion R and Vitromolar, to evaluate this roughness right after the material preparation. It was noticed that the glass ionomer cements Fuji IX, Ketac Molar and Vidiron R presented a superficial roughness acceptable; meanwhile, the glass ionomer cement Vitromolar presented a higher superficial roughness.

Mallmann et al.[26] compared the compression resistance of two glass ionomer cements, a conventional (VITRO FIL) and a resin modified (VITRO FIL LC), using two sizes of samples: one with 6mm height and 4mm of diameter, and the other with 12mm of height and 6mm of diameter, following the specification 7489:1986 of ISO and the specification nº. 66 da ANSI/ADA for glass ionomer cements. Ten-body proof of each material were made, with 40. After the tests, it was observed that the glass ionomer cement resin modified had better results, independently of the size of the body proof.

To evaluate the influence of irradiation over the dentine union to shearing´s resistance, Yesilyurt et al.[17] did a study with two types of conventional glass ionomer cements (Fuji IX e Ketac Molar Easymix). In this study, thirty extracted molars were sectioned on half,on the mesio-distal way. Half of twenty molars were irradiated with 60 Gy (5 days / week) during six weeks. Afterwards, the glass ionomer cements were placed over an irradiated dentine surface (Groups A1, B1). The other half of these teeth were placed in dentine surfaces first and afterwards irradiated (Groups A2, B2). The remaining 10 teeth were not irradiated (Control groups C1, C2). Exanimating the shear dental resistance of the glass ionomer cements, the groups A2 e B2 had a resistance of union significantly lower than groups A1, B1, C1 and C2 ($p<0.05$). There was no significantly difference within the groups A1, B1, C1 and C2 ($p>0.05$). In conclusion, the irradiation can have an adverse effect over the resistance of union of glass ionomer cements, depending on the appliance sequence.

In a similar study, Fragnan et al.[9] evaluated the hardness of three national glass ionomer cements after 24 hours and after 7 days. The materials used were Vidrion R, Vitro Molar and Maxxion R. Each of them were manipulated according to the manufacture guideline. After the tests, it was verified that the glass ionomer cement of high viscosity Maxxion R

presents higher mechanical propriety when compared to the other cements. To the other three types of glass ionomer cements, timing is essential to increase the hardness.

A study made by Zoergiebel and Ilie [20], compared the efficiency of a glass ionomer cement with zinc (Chemfil Rock) with three others conventional glass ionomer cements (Riva Self Cure, Fuji IX Fast and Fugi IX GP Extra / Equia). After storing the samples with and without an artificial saliva coating and distilling water during 7 and 30 days, the Chemifil Rock presented higher resistance to flexion, however, lower Vickers hardness, and retreat modulus. It can be concluded that this new product may have a promising future, mostly regarding the longevity of the material when fulfilling the molars region. That is due to the high resistance to flexion, and the absence of visible defects on the surface, such as fissures and emptiness.

Holmgren and Figueredo[16] did a study review about the Atraumatic Restorative Treatment technique, showing the evolution of it within the last two decades. They reported that, there is no doubt, there are improvement points, and that new research must be done for that. However, the dentist should always be careful to apply it daily.

Comparing compression resistance, and diametric traction of a glass ionomer cement of high viscosity (FUJI IX and VITRO MOLAR, both indicated to TRA), it was observed no significantly differences to the RC and TD tests. According to the study, new researches are still required, but it reflects an advance of Brazilian materials, that can be compared to materials produced worldwide[27].

It is interesting that comparing national glass ionomer cements with imported ones, Ferreira et al. (2006), showed that within the glass ionomer cements tested (Brazilians: Vidrion R and Vidrion RCaps, Imported: Fuji IX and Fuji IXGPFast capsule), none was capable of avoid cervical infiltration on class II restorations of deciduous molars, when evaluated in vitro. It was also observed that all of these glass ionomer cements presented high levels of penetration of the dye on the teeth/restoration. The Brazilian glass ionomer cements showed better performance regarding cervical micro infiltration, when compared to the imported ones.

The knowledge regarding the conventional and modified Atraumatic Restorative Treatment is still not

propagated very well. Frencken and Leal[28] explained the information of this dentistry field of minimal intervention. It is very simple; Atraumatic Restorative Treatment modified refers to the use of rotatory instruments to expose the cavity to treatment. These rotatory instruments are not used on the traditional Atraumatic Restorative Treatment, where only manual instruments are used.

França et al.[5] noticed a satisfactory clinical performance of the glass ionomer cement when used to Atraumatic Restorative Treatment restorations, and when used as fissure sealing. On this use, this material presented good retention, marginal adaptation, low deterioration, and low failure index, in period's superior to one year.

Amorin, Leal and Frencken[7] in a meta-analysis study investigated how much time sealings and restorations made by the Atraumatic Restorative Treatment technique would last. It was noticed that the use of high viscosity glass ionomer cement on single surface restorations on permanent teeth, lass more than five years. On deciduous teeth, this time was only 2 years. According to this study, the prevention effect of glass ionomer cements on sealing is satisfactory even after 3 years, specially the high viscosity glass ionomer cements.

There are several researches regarding the glass ionomer cement. For instance, Xie et al.[29] developed a new bioactive resin modified glass ionomer cement system with a therapeutic function in regard of the leveling of dentin mineralization. In this system, the acid of the system LC FUJI II (polyacrilic acid) and the bioactive glass S53P4 were used. In the control group, the tests were made using the conventional glass ionomer cement FUJI II LC. Before of the tests, all of the samples were conditioned with body fluid simulated at 37C. The effects of the aging on BFS regarding compression, resistance and toughness were investigated using electronical microscopy. The results were exciting, they showed that the new system had forces comparable with the conventional cement, and helped on the dentin mineralization in the presence of body fluid simulated. That way, it showed a possible therapeutic impact directly on the dental restorations that require root surface fulfilling.

CONCLUSIONS

Considering what has been written in literature, the glass ionomer

cements have been widely used by the dentists. Besides its most famous use, the fluoride release, its adhesion, its thermic expansion coefficient (similar to the dental structure), its biocompatibility, and its use diversity, are what makes this material so requested.

This kind of cement also has some limitations such as: dosage and manipulation sensibility, water sensibility on the first minutes of setting time, low resistance to loss and to fracture, and susceptibility to degradation on an acid environment. However, there have been a few advances on research, to overcome these limitations and produce a better material.

In conclusion, even though there are scientific advances, the knowledge of the dentist is the most important factor for the use of this material.

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