



Journal Homepage: -www.journalijar.com
**INTERNATIONAL JOURNAL OF
 ADVANCED RESEARCH (IJAR)**

Article DOI:10.21474/IJAR01/6926
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/6926>



RESEARCH ARTICLE

CAUSES OF FAILURES IN CERAMIC VENEERS RESTORATIONS: A LITERATURE REVIEW.

Rafaela Mendes Romão¹; Gabriel da Rocha Scalzer Lopes²; Jefferson David Melo de Matos³; Guilherme da Rocha Scalzer Lopes⁴; John Eversong Lucena de Vasconcelos⁵; Natasha Muniz Fontes⁶.

1. School of Dentistry, Centro Universitário UNILEÃO, Juazeiro do Norte – CE, Brazil.
2. School of Dentistry, Faculdade Multivix, Vitória – ES, Brazil.
3. Post Graduate Student - Masters Degree Program, Department of Prosthodontics, Universidade Estadual Paulista Júlio de Mesquita Filho UNESP, São José dos Campos - SP, Brazil.
4. Post Graduate Student - Ph.D Program, Department of Prosthodontics Department, Universidade Estadual Paulista Júlio de Mesquita Filho UNESP, São José dos Campos - SP, Brazil.
5. Professor of Oral Implantology, Department of Dentistry, Centro Cariense de Pós-Graduação CECAP, Juazeiro do Norte – CE, Brazil.
6. Master's Degree of Orthodontics, Department of Dentistry, San Leopoldo Mandic SL MANDIC, Campinas – São Paulo.

Manuscript Info

Manuscript History

Received: 12 February 2018
 Final Accepted: 14 March 2018
 Published: April 2018

Keywords:-

Dental Aesthetics; Dental Veneers;
 Dental Restoration Failures; Ceramics.

Abstract

Aim: In an attempt to clarify the techniques used in ceramic veneers due to the scarce literature on the subject, it is aimed, through a review of literature, to analyze the main causes of failures of this type of procedure. **Methodology:** An electronic search of publications was carried out in the following databases: Google Scholar, PubMed, SciELO; using the following descriptors: Esthetic Dental, Dental Veneers, Dental Restoration Failure and Ceramics. The following were adopted as inclusion criteria: articles published in English and Portuguese, articles published between the years 2000 to 2018 and articles whose subject matter is restricted to the subject of ceramic veneers. **Results:** Through the review, all the works presented that the ceramic veneers restorations consist of a very interesting prosthetic alternative for teeth shape modification, position in the matter of slight corrections, correction of structural defects, color modification, occlusal rehabilitation, among other indications. It is often possible to return the aesthetic balance of the smile with little or no dental wear, which characterizes the procedure as minimally invasive and relatively conservative, when compared to total crowns that always require greater reduction of dental structure. **Conclusion:** There are certain factors that are of great importance for the success and longevity of the procedure as the correct indication of the treatment and adequate choice of the restorative material, followed by dental preparation; the use of the precise technique, with the field isolated and free of any contamination.

Copy Right, IJAR, 2018.. All rights reserved.

Corresponding Author:- Rafaela Mendes Romão.

Address:- School of Dentistry, Centro Universitário UNILEÃO, Juazeiro do Norte – CE, Brazil.

Introduction:-

Science has always sought to meet the new demands of needs and often of the dreams that the modern world brings; through the availability of resources, strategies and techniques, thus satisfying those who use the most varied forms of their services. Aesthetic dentistry is directly or indirectly responsible for one of the most expressive tools of the natural beauty of the human being¹.

Currently the profile of patients seeking dental care are those who care about oral aesthetics, the search for consumers to achieve the perfect smile is leading the dental market to a constant growth, where this goal can be achieved. With this scenario, of the ceramics in which they have shown a rapid evolution in the scientific field, in order to improve their physical and mechanical properties, to meet the aesthetic needs that are increasingly demanded by modern society. In this context, it is necessary to know each ceramic system currently available in the market, from its main characteristics to its limitations.².

To indicate correctly, it is important to know what to use in each specific clinical situation, since the clinical longevity of the restorations is a result of a combination of different factors such as: mechanical properties of materials, damage caused by processing methods (casting, machining, sintering) and the cyclic loads to which the materials are subjected when in function. The anterior teeth have fundamental importance in the aesthetics of the face, and for this reason, they are highly valued by the patients who wish to lighten, to increase the anatomy or position of the teeth, in the search for a more natural and harmonic smile³.

The most frequent reasons that lead to aesthetic dentistry are related to tooth discoloration due to caries, broad restorations and traumas; situations that can be reversed by the use of restorative procedures, such as porcelain veneers. The use of ceramic veneers is an important measure adopted in order to remedy possible momentary damages, the application of ceramics, the procedure by professionals in occupational sciences in the area of dentistry and aesthetics. It is an aesthetic procedure most sought mainly by people whose work is linked to an appearance and often related to a self-esteem⁴.

The use of porcelain veneers and other types of metal-free restorations is to restore malformed and poorly positioned teeth, teeth that exhibit color changes involving the vestibular face; can be done by direct or indirect techniques, where the professional must maintain similar optical, mechanical and biological properties with the natural enamel; besides qualities such as biocompatibility, durability, high compressive strength, coefficient of thermal expansion close to dentin and color stability; thus the ceramic veneers were able to combine the conservative requirement of their preparations with their resistance, biocompatibility and aesthetic qualities⁵.

However, all this excellence can only be achieved if there is knowledge of the basic principles of dental aesthetics, as well as the excellent mastery of the technique beyond indication, choice of material, correct technique and follow-up. It can then present disadvantages such as the need for preparations with greater wear of dental structure, marginal maladaptation, dentin sensitivity, and even fractures⁶. Primeiramente, surgiram às porcelanas feldspáticas, com propriedades não muito agradáveis como fragilidade sob tração e a fratura. Initially, these ceramic systems appeared in feldspathic porcelains, with not very pleasant properties, such as brittleness under traction and fracture; and with the evolution of these materials, the reinforced ceramics were created, with the addition of crystals such as alumina, leucite, lithium disilicate and zirconia, that increase the resistance of the material, and these innovations made possible the use of minimally invasive and thick⁷.

In an attempt to clarify the techniques used in ceramic veneers due to the scarce literature on the subject, it is aimed, through a review of literature, to analyze the main causes of failures of this type of procedure.

Methodology:-

An electronic search of publications was carried out in the following databases: Google Scholar, PubMed, SciELO; using the following descriptors: Esthetic Dental, Dental Veneers, Dental Restoration Failure and Ceramics. The following were adopted as inclusion criteria: articles published in English and Portuguese, articles published between the years 2000 to 2018 and articles whose subject matter is restricted to the subject of ceramic veneers (FIG.1).

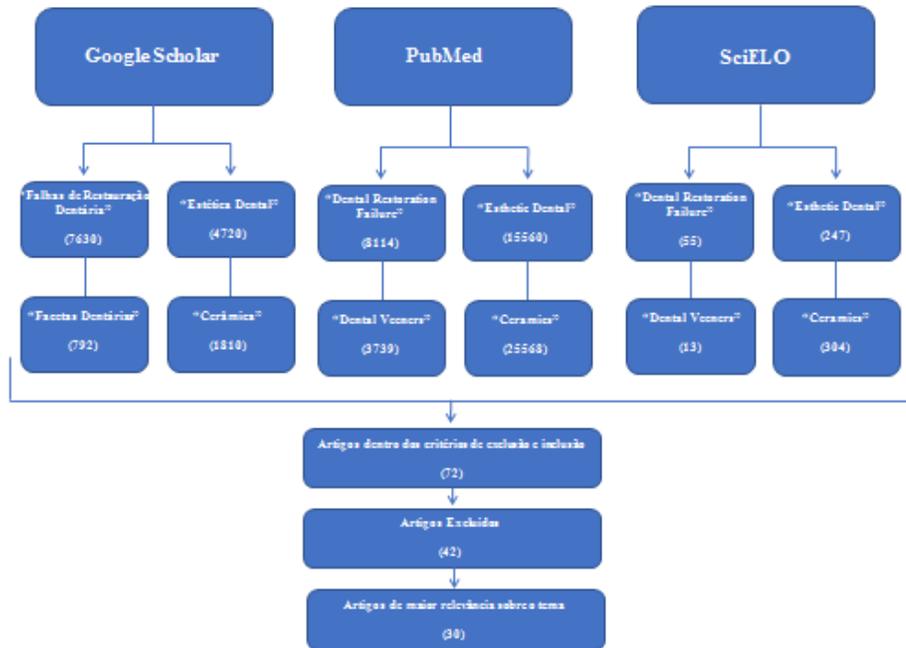


Figure.1:-Descriptive chart of the methodological proposal.

Results:-

Through the review, all the works presented that the ceramic veneers consist of a very interesting prosthetic alternative for teeth shape modification, position in the matter of slight corrections, correction of structural defects, color modification, occlusal rehabilitation, among other indications. It is often possible to return the aesthetic balance of the smile with little or no dental wear, which characterizes the procedure as minimally invasive and relatively conservative, when compared to total crowns that always require greater reduction of dental structure (Chart. 1).

Chart. 1:- Author, kind of study, aim, methodology, variables and results of the reviewed studies.

Author	Kind of study	Aim	Methodology	Results
Assis et al., 2013 ¹²	Literature Review	Indicate the main causes of failures in porcelain veneer restorations.	Original articles on the subject were selected in journals listed in Pubmed and Medline from 1997 to 2013.	In order to achieve success, it is necessary, firstly, the planning, in order to determine the most appropriate choice of materials and technique employed.
Zavanelli et al., 2018 ²²	Literature Review	To present a literature review in which the aim is to characterize porcelain veneers.	A bibliographic research was carried out in the main health databases, from 2007 to 2017.	Analyzing the performance of ceramic veneer, seen in the review work, show high acceptability by patients, with excellent esthetic maintenance, for periods of 10 years.
Gonzalez et al., 2012 ²⁰	Literature Review	Collect scientific data on ceramic laminated veneers faults.	The review was conducted by searching for original articles on the subject in Pubmed periodicals from 1990 to 2012.	The most important parameters to determine the success and longevity of the laminates are: correct selection of the case, use of the ceramic as a restorative material, preparation in

				enamel following a wear technique, among others.
Benneti et al., 2003 ⁴	Literature Review	To present a literature review with the main characteristics of porcelain veneers.	A bibliographic search was carried out in the main health databases, from 2001 to 2003.	Indirect veneering in porcelain has been shown to be efficient and is currently considered the treatment of choice for cases of heavily darkened and / or widely restored teeth.
Bispo., 2009 ⁵	Literature Review	To describe a brief review on the use of aesthetic ceramic veneers as an aesthetic and conservative principle of dental elements that present forces of segregation.	A bibliographic search was carried out in the main health databases, from 2000 to 2009.	Like all and any restoration procedure the ceramic veneers has its indications and contraindications that must be thoroughly investigated for the correct return of the harmony, the naturalness and the beauty of the smile
Mondelli et al., 2003 ¹¹	Literature Review	To present a broad approach regarding the use of ceramic veneers as aesthetic and functional rehabilitation treatment of anterior teeth.	A bibliographic search was carried out in the main health databases, from 2000 to 2003.	The use of ceramic veneers for the aesthetic and functional rehabilitation of the anterior teeth, associated or not with other cosmetic treatments, when well indicated, planned and made, presents itself as an excellent restorative option.
Bertoncelo et al., 2018 ²⁴	Laboratory study (In vitro)	The objective of this study was to evaluate in vitro the influence of three different ceramic veneers methods on the marginal adaptation, before and after adjustment, and in the internal adaptation, after adjustment.	For each prepared tooth, three ceramic veneers were prepared, according to the cooking method, totaling 30 ceramic veneers (10 per method): G1 - agglutination method (refractory model); G2 - injected ceramics method (IPS Empress); G3 - computerized method (CEREC).	The marginal adaptation was done by measuring the maximum value of the discrepancy between the margin and the dental preparation and the internal measurement of addition silicone (Fit Checker II, GC), used for the simulated feed.
Zhang et al., 2006 ¹⁴	Laboratory study (In vitro)	It compared the initial fatigue strengths of particles on the ceramics of alumina and zirconia.	Alumina or zirconia plates bonded to polycarbonate substrates, in which they were subjected to single-cycle and multi-cycle contact loads (fatigue). The ceramic cementation surfaces were damaged by controlled abrasion of particles, retreatment with a low charge sharp diamond, or a blunt penetrator at high load. The stresses required to	Damage caused by particle abrasion, not necessarily are immediately apparent, compromised the fatigue strength of zirconia and alumina ceramics in crown-like structures. In the case of fatigue, small faults introduced by abrasion of particles can overcome any compensatory reinforcing effect of compression associated with surface damage or, in the case of zirconia, with phase transformation.

			initiate the radial fractures were evaluated.	
Magalhães et al., 2013 ¹⁵	Laboratory study (In vitro)	To evaluate the influence of the color of resinous cementitious agent on the final color of minimally invasive porcelain veneers after accelerated artificial aging.	Twenty bovine teeth were collected, prepared and divided into two groups. The roots were removed and the vestibular surfaces were polished to obtain a flat surface. Porcelain discs (IPS Empress Esthetic) were produced in a standardized hue (ET1) and thickness (0.6mm).	When comparing the cements, the Y cement showed higher ΔE , lower L and higher b after AAA than WO. Both cements could mask the color of the substrate. With AAA, only the Y-tone showed a clinically unacceptable ΔE , becoming more yellow (greater b) and losing lightness (L lower).

Discussion:-

The restoration made with porcelain veneers gives quality, when the dental aesthetic joins the gingival health, it is a restoration that only involves the vestibular face of the teeth; It can be made with composite resin (directly in the patient's mouth) or with porcelain, which brings aesthetic and color stability advantages, also performed in the laboratory, ie outside the mouth; the Restorative Dentistry presented the ceramic veneers in an innovative, resistant and efficient way, favoring in its aesthetic result (Fig. 2)⁸.



Figure. 2:- Porcelain veneers.

The first point to be observed when planning a treatment is the range of possibilities for each case, analyzing in detail the situation of each patient, it is possible to arrive at the indication of a certain treatment; in the case of ceramic veneers restorations, several are the contraindications, beginning with the wrong selection of the case. Eight indications are prioritized for porcelain laminated veneers: caries, microdontia, conical teeth, malformed teeth, teeth discolored by devitalization, teeth altered by color restorations, teeth altered by color (tetracycline, fluorine), spaced teeth, diastema, , teeth with abrasion or attrition, prosthetic treatment of young patients with permanent dentition⁹. A very important factor in the planning of any treatment is the patient's opinion, in which the best option that fits your case, both in terms of oral health and in economic terms, must be analyzed together with it; must not only obey the aesthetic desires of consumers, nor the capitalist thinking of the professional¹⁰.

Attention should be given to cases with inflamed periodontium and short labial bracings, which in turn may have obstacles that may impair the smile. Patients who present parafunctions such as bruxism and hardening, teeth with diminished coronary structure, evident crowding, vestibularized, rotated and attempt to fill diastemas in which they

are serious, probably generate failures. Extensive pre-existing restorations also tend to generate flaws. The palatal region of the teeth needs to be healthy or little restored, as it is a very important factor for the success of the indication¹¹.

The selection of the material to be used should be done together with the planning of the case, respecting the limits and the appropriateness of each material, to avoid failures. Among the main materials that stand out most are Feldspar which is a mineral with high concentration of potassium oxide that confers great resistance to porcelains; Silica and Oxygen which are components added to dental porcelains as a vitreous matrix, in addition to some other oxides, such as Alumina, which confer the same qualities of melt temperature, viscosity, mechanical strength, translucency and opacity; this in turn, having ideal characteristics, in which they provide greater resistance to reduce points of tension during their cooling, thus blocking the propagation of cracks and avoiding possible fractures¹².

The tooth preparation should provide an adequate dimension and space for the material where the ideal thickness of 0.5mm; it is necessary to remove convexities to create a defined insertion path according to the wrapping of the surfaces, the best route of insertion is the one that requires the least tissue reduction, satisfying the aesthetic and biological demands, besides providing adequate space for the masking of dark spots and for the cementing agent to be able to perfectly fit the ceramic veneers to the full extent (Fig. 3)¹³. It is necessary to adjust the margins through a final finishing line of the preparation, facilitating the intra-sulcular location when aesthetics so require; the margin of the ceramic veneers should remain at the gingival border or with a minimal extent in the groove. Adjustment and margins finishing are more important from the periodontal point of view, and no significant differences were found between the sub and supragingival sites¹⁴.



Figure. 3:- Ideal thickness for correct ceramic veneers seating.

If there is not sufficient wear the space for the ceramic veneers is not ideal, however, if there is too much wear and tear, the enamel areas can be removed and this damages the adhesion because the resin cement and tooth interface is the first entrance region of the oral fluid. Then, the adhesive failure occurs in 80% or more of the cases when the remainder is of dentin, being very unlikely when a minimum of 0.5 mm of enamel is preserved; the wear must be homogeneous, as this allows a standardized thickness of ceramic along the tooth, which increases its resistance. Where the three main techniques are: free hand wear guide with orientation grooves, the orientation groove method recommends a marking with frustoconical drills with rounded end of grooves (dimple method) with the desired depth¹⁵.

The dimple method uses spherical drills of small diameter to mark at various points of the preparation the limit of wear. Comparing the techniques, the use of small diameter spherical drills and the creation of only one central groove are those that approach the ideal depth. In the silhouette technique, orientation grooves must be performed to

control the depth of wear, a cervical groove is made and then the axial¹⁶. Then, the joints of these grooves are only joined in one half of the tooth, so that a uniformity of wear is visualized, preceded by wear on the other half of the tooth. In the interproximal area, the vestibular preparation is exceeded, in which the final characteristic resembles a "U", preserving the proximal contact in tooth structure (Fig. 4)¹⁷.



Figure. 4:- Preparation for ceramic veneers by the dimple method.

In order for the margin of the ceramic veneers not to be visible, it is necessary to locate it slightly lingually in the region of the interdental papilla, an area that determines the mode of insertion of the ceramics, avoiding the creation of a retention area (Figure 5). For the success of a mold, the preparation should be well made, having particular characteristics such as smoothness and satisfactory polish¹⁸. Silicone and polyester materials are the first choice, silicone by addition reaction, is recommended; because it meets the requirements of the job and they are more stable. It is also recommended to perform the molding with the use of retractor wire, as it facilitates the identification of the preparation lip, fidelizing the copy of the cervical piece, avoiding failures (Fig. 6)¹⁹.



Figure. 5:- Insertion of the retractor wire, intrasulcular region.



Figure. 6:- Molding on double wire technique.

It is advised to send as much detail as soon as possible to the laboratory, such as the color and the description of the limits, so that the restoration can achieve the desired success. It is suggested that, for a complete laboratory prescription, the tonality of the prepared teeth should be recorded; the degree of shade of the laminates; a suitable interface space obtained by the application of the array spacers; the level of translucency / opacity of the laminates; the anatomy, texture and surface gloss of the laminate; the length, the contacts and the incisal shape of the laminates (Fig. 7)²⁰.



Figure. 7:- Diagnostic closure for case planning.

It is indicated that these procedures must be cemented by means of resin cement, which presents excellent interfacial sealing, is practically insoluble, and allows the transfer of the tension generated on the ceramic to the support structure, which confers a greater extrinsic resistance of the ceramics²¹. Adhesive cementation, on the other hand, basically involves an interrelation between the surface treatment, cleaning of the adhesives and obviously the proper selection of the cementing agent. In porcelain veneers the cementing agent is the weakest link in the system because there is still the contraction of volumetric polymerization that can create a marginal opening or marginal seal loss²².

The thickness of the cement also influences the final result; in this way the ceramic veneers is more resistant when cemented, presenting its thickness three times more reinforced than normal, implying the need to prepare the dental surface in this proportion, in order to avoid excessive configuration. The color of the cementitious composite should also be taken into account in the treatment of ceramic laminates, the color of the porcelain should be approximated as close as possible to the color of the adjacent tooth. However, the final color of the translucent ceramic restorations

is determined by the thickness of the porcelain, the color and thickness of the cementing agent and the color of the underlying dental structure²³.

For cementation of porcelain veneers a light-curing cement is the preferred one, because the resin cement, although it matches the color of the substrate at the time of cementation, can change its color as time passes, becoming dark and with loss of luminosity²⁴. While photopolymerisable, they exhibit greater color stability and working time compared to chemically cured and dual cure cements; the use of this type of cement facilitates the removal of excess material prior to polymerization and reduces the time required for finishing after the restoration has been cemented²⁵.

All adjustments in the porcelain veneers should be corrected before cementation so that the laboratory can apply the final glaze to the external surface of the restoration²⁶. Corrections performed after this procedure result in a rough and dull surface, being more prone to spotting by extrinsic staining²⁷. If any post-cementation correction is required, it can be performed with fine diamond and microfine finishing drills, under-chilling, thin-edged and microfine silicone tips, 30-blade finishing drills, discs and sanding strips (Fig. 8)²⁸.



Figure. 8:-Aesthetic adjustment of the ceramic veneers.

Is important to note that the rougher the porcelain surface, the lower the flexural strength of the porcelain. Therefore, it is recommended that the ceramic veneers be carefully polished²⁹. Although the development of caries lesions on the margins of the restoration is rare, with the exception of patients with high activity of carious lesions, the sealing of the final margins of porcelain restoration reduces infiltration in all interfaces³⁰.

Final considerations:-

It can be concluded from this study that:-

There are certain factors that are of great importance for the success and longevity of the procedure as the correct indication of the treatment and adequate choice of the restorative material, followed by dental preparation; the use of the precise technique, with the field isolated and free of any contamination. On the other hand, the cementation phase is critical and should be performed perfectly, following the correct technique, without saving time or neglecting possible steps, so the chance of success of this type of restoration increases, and the probability of failure decreases.

Conflicts of interest:-

The authors declare that there are no conflicts of interest.

References:-

1. Wassell RW, Walls AW, Steele JG. Crowns and extra-coronal restorations: materials selection. *Br Dent J.* 2002;192(4): 199-202.
2. Krämer N, Lohbauer U, Frankenberger R. Adhesive luting of indirect restorations. *Am J Dent.* 2000;13(Spec No): 60D-76D.
3. Baratieri L, Monteiro Junior S, Andrada M, Vieira L, Ritter A, Cardoso A. Odontologia restauradora: fundamentos e possibilidades. In *Odontologia restauradora: fundamentos e possibilidades.* 2002: 739.
4. Benetti A, Miranda C, Amore R, Pagani C. Facetas indiretas em porcelana-alternativa estética. *JBD, J. Bras. Dent. Estét.* 2003; 2(7): 186-194.
5. Bispo, L. B. Facetas estéticas: status da arte. *RDO.* 2009; 8(18): 11-4.
6. Sorrentino R, Galasso L, Tetè S, De Simone G, Zarone F. Clinical evaluation of 209 all-ceramic single crowns cemented on natural and implant-supported abutments with different luting agents: a 6-year retrospective study. *Clin Implant Dent Relat Res.* 2012 Apr;14(2):184-97.
7. Cardoso P, Cardoso L, Decurcio R, Junior L. Restabelecimento estético funcional com laminados cerâmicos. *Revista Odontológica do Brasil Central.* 2011; 20(52).
8. Gomes E, Assunção W, Rocha E, Santos P. Cerâmicas odontológicas: o estado atual (Ceramic in dentistry: current situation). *Cerâmica.* 2008; 54: 319-325.
9. Gonzalez M, Ritto F, Lacerda R, Sampaio H, Monnerat A, Pinto B. Falhas em restaurações com facetas laminadas: uma revisão de literatura de 20 anos. *Revista Brasileira de Odontologia.* 2012; 69(1): 43-48.
10. Kina S. Cerâmicas dentárias. *Rev. dental press estét.* 2005; 2(2): 111-128.
11. Mondelli R, Coneglian E, Mondelli, J. Reabilitação estética do sorriso com facetas indiretas de porcelana. *Biodonto.* 2003; 1(5): 22-43.
12. De Assis R, Sarmento H, Branco A, Campos F, Pereira S, De Assunção R. Desempenho Clínico de Restaurações Cerâmicas Livres de Metal: Revisão da Literatura. *Revista Brasileira de Ciências da Saúde.* 2013; 17(3): 309-319.
13. Souza M, Neto O, De Oliveira R, De Castro S. Laminados cerâmicos—um relato de caso. *Revista Pró-UniverSUS.* 2016; 7(3): 43-46.
14. Zhang Y, Lawn B, Malament, K, Thompson V, Rekow E. Damage accumulation and fatigue life of particle-abraded ceramics. *International Journal of Prosthodontics.* 2006; 19(5).
15. De Magalhães A, De Siqueira P, De Carvalho Cardoso P, De Souza J, Fonseca R, Lopes L. Influence of the resin cement color on the shade of porcelain veneers after accelerated artificial aging. *Revista Odontológica do Brasil Central.* 2013; 22(60).
16. Malheiros A, Fialho F, Tavares R. Cerâmicas ácido resistentes e a busca por cimentação resinosa adesiva Acid resistant ceramics&58; the search for resinous adhesive cementation. *Cerâmica.* 2013; 59(349): 124-128.
17. Menezes M, Carvalho E, Silva F, Reis G, Borges M. Reabilitação estética do sorriso com laminados cerâmicos: Relato de caso clínico. *Rev Odontol Bras Central.* 2015; 24(68): 37-43.
18. Aquino A, Cardoso P, Rodrigues M, Takano A, Porfírio W. Facetas de porcelana: solução estética e funcional. *Clín. int. j. braz. Dente.* 2009; 5(2): 142-152.
19. Gresnigt M, Özcan M. Esthetic rehabilitation of anterior teeth with porcelain laminates and sectional veneers. *Journal of the Canadian Dental Association.* 2011; 77(6): 371.
20. Alavi AA, Behroozi Z, Nik Eghbal F. The Shear Bond Strength of Porcelain Laminate to Prepared and Unprepared Anterior Teeth. *J Dent (Shiraz).* 2017 Mar;18(1):50-55.
21. Font A, Ruiz F, Ruíz M, Rueda C, González A. Choice of ceramic for use in treatments with porcelain laminate veneers. *Med Oral Patol Oral Cir Bucal.* 2006; 11: 297-302.
22. Zavanelli, A, Caetano J, Da Silva, L, Zavanelli R. Previsibilidade do tratamento estético com lentes de contato cerâmicas. *Archives of Health Investigation.* 2018; 6(12).
23. Diegues M, Marques E, Miyamoto P, Penteado M. Cerâmica X Resina Composta: O Que Utilizar?. *Revista Uningá.* 2018; 51(1).
24. Bertonecelo A, Moreira A, Archangelo M, Silva D, Sábio S, Corrêa D. Avaliação in-vitro da resistência mecânica de laminados cerâmicos em pré-molares superiores com cobertura total da cúspide vestibular. *Revista Uningá Review.* 2018; 19(1).

25. Vanoorbeek S, Vandamme K, I. Lijnen, Naert I. Computer-aided resina composta fabricada / assistida por computador versus cerâmica restaurações unitárias: um estudo clínico de 3 anos. *Int J Prosthodont.* 2010 Maio-Jun; 23 (3): 223-30.
26. Sethi A, Makkar S, Sidharth K, Kaur T, Sandhu SS, Joseph AK. Evaluation of the Flexural Strength of Submicron Hybrid Composite using Different Fabrication Methods: An in vitro Study. *J Contemp Dent Pract.* 2018 Feb 1;19(2):205-209.
27. Tripodakis AP, Gousias HC, Andritsakis PD, Tripodaki EA. Evaluation of alternative approaches in designing CAD/CAM frameworks for fixed partial dentures. *Eur J Esthet Dent.* 2013 Winter;8(4):546-56.
28. Zorba YO, Bayindir YZ, Barutcugil C. Facetas laminadas diretas com resina compósitos: dois relatos de caso com cinco anos de acompanhamento. *J Contemp Dent Pract.* 1 de julho de 2010; 11 (4): E056-62.
29. Boeckler AF, Lee H, Stadler A, Setz JM. Prospective observation of CAD/CAM titanium ceramic single crowns: a three-year follow up. *J Prosthet Dent.* 2009 Nov;102(5):290-7.
30. Vigolo P, Mutinelli S. Evaluation of zirconium-oxide-based ceramic single-unit posterior fixed dental prostheses (FDPs) generated with two CAD/CAM systems compared to porcelain-fused-to-metal single-unit posterior FDPs: a 5-year clinical prospective study. *J Prosthodont.* 2012 Jun;21(4):265-9.