

# Endocrown With Cad Cam Technology

Nathaly Michelle Alcocer Varela<sup>1</sup>, Janeth Alexandra Salvador Arroba<sup>2</sup>, Ariel Jose Romero Fernandez<sup>3</sup>, Diego Mauricio Laverde Albarracín<sup>4</sup>

<sup>1</sup>Career of Dentistry Regional University Autonomous of the Andes (UNIANDES).

Email: [oa.nathalymav61@uniandes.edu.ec](mailto:oa.nathalymav61@uniandes.edu.ec)

<sup>2</sup>Career of Dentistry Regional University Autonomous of the Andes (UNIANDES).

Email: [ua.janethsalvador@uniandes.edu.ec](mailto:ua.janethsalvador@uniandes.edu.ec)

0000-0003-1667-4328

<sup>3</sup>Research Directorate of the Regional Autonomous University of the Andes (UNIANDES).

Email: [dir.investigacion@uniandes.edu.ec](mailto:dir.investigacion@uniandes.edu.ec)

0000-0002-1464-2587

<sup>4</sup>Affiliation: UNIANDES Teacher

Email: [ua.diegolaverde@uniandes.edu.ec](mailto:ua.diegolaverde@uniandes.edu.ec)

0000-0003-2421-0363

## Abstract

The rehabilitation of endodontically treated teeth has various clinical characteristics and properties that are different from vital pieces, such as their structure, resistance, and hydration. That is the reason why it makes it difficult for the professional to restore them. The objective is to select the most resistant material to create crowns in endodontic teeth. It was done through updated bibliographic research for the elaboration of endocrowns with CAD/CAM technology. Materials and Methods: The current research work is based on an analytical and descriptive approach of scientific articles about the resistance of the most suitable material used for the elaboration of endocrowns with CAD CAM technology. A bibliographic review of the last 5 years was carried out, from 2016 to 2021. The review consisted of 50 scientific articles found on different publication and search platforms such as: Google Scholar, Scielo, Pubmed, Clinical Key. After applying inclusion and exclusion criteria, 27 articles were chosen. Those articles met the research focus. Results showed that the most used material which reflects greater stability regarding the forces present in chewing is lithium disilicate. It was also determined that lithium disilicate is also a good alternative in aesthetic cases when requiring an endocrown-type restoration, even in parts of the tooth where an aesthetic is vital. After the bibliographic review some conclusions were drawn, the first one concerning lithium disilicate as an optimal restorative material that, when designed and milled by CAD CAM, together with an adequate and updated adhesive protocol, provides stability and lower risk of fracture, which allows a restoration of long-lived endocrown types and minor intervention of the dental pieces.

**Keywords:** endocrowns, resistency, dental ceramics, CAD/CAM, fractures

## 1. Introduction

Devitalized teeth have various clinical characteristics and properties different from vital pieces such as: their structure, resistance, integrity and hydration, therefore, also severe damage such as: excessive removal during root canal treatment, weakening by irrigants, intraduct medication, aggressive effects of restorative materials, or excessive occlusal forces, ends up hindering their rehabilitation by the professional.<sup>1</sup>

The endocrowns or in Spanish, endocoronas, so called because it is a restorative component of the clinical crown, with an adhesive retention that encompasses the axial walls of the pulp chamber, forming a monoblock, so it is essential that the endocorona is made by a material that has: good elasticity similar to the dental structure, excellent mechanical resistance and high capacity of union with the dental structure since it aims to prevent recolonization of bacteria, restore the coronary and cameral anatomy, good sealing of the root canal.<sup>2</sup> Currently the computerized CAD-CAM technology

has allowed to provide patients with new expectations of treatment, since it offers a wide range of advantages in the elaboration of fixed prostheses such as: less time in its elaboration providing accuracy, aesthetics and a correct adaptation, gaining a micromechanical retention, it also offers several alternatives of hybrid materials appropriating each need, so it gives the patient greater comfort at the time of the procedure.<sup>3</sup>

For a long time it has been using posts or cores to perform the rehabilitation of an endodontic tooth treated, so it has been proven over time that there is a mismatch between the rigidity of the endoposts (fiberglass —cast metal) and dental tissues, that is to say that their adaptation is not ideal increasing the risk of root fractures, perforations during the procedure, resulting in an unfavorable long-term prognosis.<sup>4</sup>

The endocoronas are a treatment with a good prognosis when treating teeth with a root canal treatment, its easy preparation that is usually supra gingival, does not affect the periodontium and allows it to withstand the normal occlusal forces

avoiding the fracture of the same. According to Dogui, et al, the elaboration of endocoronas in the CAD CAM system once rehabilitated in the mouth has had a success in 90.5% in molars and 75% for premolars in 55 patients studied, which indicates that it is a hopeful treatment, that even having bruxism or little dental remnant endocoronas are a viable treatment that will allow occlusal stability and avoid fracture of endodontically treated teeth. <sup>5</sup>

The different materials with which endocrowns are manufactured, are very important in terms of the fracture of the dental organs, materials that have elasticity models identical to dental ones, usually have a better prognosis in the treatment of endodontic teeth. According to Kanat, et al, indicates that zirconium, lithium and lithium disilicate ceramic groups can be used ideally in the manufacture of endocrowns since they allow to have a high resistance to dental fracture. In the same way the depth of the preparation only has significant importance when materials with feldspathic ceramics are going to be used since this influences their resistance to dental fracture, in the other materials the depth has no significant differences. <sup>6</sup>

Restorative dentistry allows to elaborate endocoronas in temporary teeth treated by pulpotomy, to be elaborated there are different materials that meet ideal measures in pediatric dentistry such as PINC (vita enamic) demonstrating in studies that it has favorable results such as: physical properties similar to dentin, it is aesthetic, it presents a correct occlusal fit and there is a minimum wear of 27.6 µm in the antagonist tooth, Therefore, to ensure clinical success, the

following indications for restoration, for example: the minimum thickness of the incisal border and occlusal cusps should be 1.5 mm; resulting in optimal mechanical properties in a deciduous tooth. <sup>7</sup>

The evolution of dental techniques, such as adhesive techniques, has made it possible to implement different more conservative treatments such as endocrowns, avoiding eliminating healthy and important tissue for tooth support, helping to obtain much more own dental structure for a better splint effect, apart from new technologies such as CAD-CAM have been obtaining better detail, Precision and compatibility at the time of the elaboration of these prosthetic structures, improving both aesthetics and function within the oral cavity. <sup>8</sup>

According to Lima et al. endocoronas are indicated in: limited interocclusal space, the teeth must have a maximum of 3 mm of occlusal height, teeth with different root anatomy, such as: curvatures, dilacerations, narrow or conical ducts that prevent the retention of endoposts, in molars that present clinical crown so it is important to know that they are divided into three classes according to the remaining dental structure: Class I, is the preparation that involves 2 walls of the cusps having a height greater than half of the original height; Class II, has a wall at the top where the height is greater than the original; Class III, all walls and cusps are decreased more than

half of the original height; It is essential to take into account the proposed indications and what kind of endocorona is going to be performed, for its proper execution and functional longevity. <sup>9</sup>

The endocrowns are intended to reduce the fracture of the tooth, in addition to being highly aesthetic and comply with a correct functionality, so it is essential to perform all the preoperative steps such as x-rays to observe the position of the roots and especially a successful endodontics, for its preparation itself all the reference points of the cavitory preparation that is going to be carried out among them must be taken into account: Its angles, depth, width, since all these points must be within the indications to perform this type of restorations. <sup>10</sup>

As a general objective, the most resistant material in the preparation of crowns in endodontic teeth will be selected through updated bibliographic research for the elaboration of endocrowns with CAD CAM technology.

## 2. Methods

This research is based on an analytical and descriptive approach of scientific articles about the resistance of the best material used for the manufacture of endocoronas with CAD CAM technology.

### Research according to the approach

This study has both a qualitative and quantitative approach, so a review of several articles was carried out to find the best material with which endocoronas are made and the success rate of several materials presented in the different scientific articles will also be observed.

### Type of research according to the objective

This research was carried out in order to find an ideal, resistant and durable material to make endocoronas with CAD CAM technology, which allows to better rehabilitate the endodontically treated teeth, giving them a favorable result with a functional longevity, allowing occlusal stability and adequate oral health.

### Type of research by scope

This article is descriptive, because it will inform about the different benefits of the different materials for the elaboration of endocoronas with CAD CAM technology, as well as the disadvantages that arise, focusing on both the positive and negative relationship with the different anatomical structures of the dental organ.

### Population

It consisted of 50 scientific articles found on different search platforms such as: Google Scholar, Scielo, Pubmed, Clinical Key. They were analyzed as they maintained relevance in terms of the title and keywords related to the present research, later it was applied on the same inclusion and exclusion criteria described later.

### Sample

27 articles were selected using inclusion and

exclusion criteria, including 10 systemic reviews, 5 case reports, 6 review articles, 2 descriptive studies, 2 scientific journals, 2 postgraduate theses.

### Inclusion Criteria

Of the 50 articles investigated, 27 were analyzed because they were considered relevant because of the title and their content, also because they met the inclusion criteria when published in the last 5 years among other criteria explained below:

-Systemic analysis, meta-analysis or case reports in English, Portuguese and Spanish.

~~Scientific articles on methods and techniques for the fabrication of endocrowns with CAD-CAM technology.~~

~~Publications of articles, scientific journals, postgraduate theses in the period 2016–2021.~~

-Scientific articles that present clinical cases of patients with various long-term prognoses in the elaboration of endocrowns.

-Scientific articles that determine the material for endocrowns more resistant to fractures in endodontically treated pieces.

### Exclusion Criteria

Of the articles analyzed, 23 were excluded because they were not related to the topic and because they were not publications within 5 years of antiquity, among other criteria explained below:

-Articles, journals and postgraduate theses published with 6 or more years old.

-Articles or texts that are not indexed.

-Scientific articles on reconstruction of endodontically treated anterior teeth

## 3. Document Analysis

For the preparation of the review article, documentary analysis was taken as a method, with the aim of obtaining a general and detailed description of the content related to the main theme and the subtopics mentioned at the beginning of the study, in the databases keywords in English and Spanish were used as a search strategy, such as: endocrowns, endodontically treated teeth, rehabilitation, CAD CAM technology, resistance, endodontics, restorative dentistry, aesthetics.

## 4. Results

The different studies analyzed show a success rate between 95 and 100% of cases. There were no significant variations between cemented endocrowns in the posterior and anterior sector in terms of fracture resistance, since they behave similarly when using ceramic or hybrid materials manufactured in CAD CAM systems. 90% of the literature mentions that the results obtained in terms of anatomical appreciation and similarity to natural teeth, is considerably superior in the manufacture of this type of restorations, when its design is assisted by digital tools such as CAD / CAM. <sup>3,4,5,7,11,15,19,21</sup>

Of all the articles reviewed, 89.5% mention that the elaboration of endocrowns in CAD CAM technology

presents a correct adaptability since thanks to its anatomical accuracy, and natural morphology it has a correct marginal adjustment thus giving stability, retention and support to the prosthetic monoblock, avoiding the weakening of the remaining walls of the tooth, safeguarding the periodontal structures and distributing the occlusal forces to which the prosthesis is subjected.

It was observed in 85% of the publications analyzed that dental preparation is decisive in the success rate of this treatment, although the use or need to maintain a ferrule as in traditional techniques is lower.

<sup>8,9,11,22,23,24</sup>

Although the treatment by endocrowns assisted by CAD CAM is not new, 90% of the authors refer to the need to maintain and establish a carving and cementation protocol adjusted to the material selected for the case, as a result of the constant updating of biomaterials used in this type of adhesive procedures and available in the global market. It should be noted that the type of preparation used can increase or decrease the possibility of micro fractures in the restoration-cement-tooth junction, by

Both the preparation technique is highly conditioning to the final success of the treatment.

<sup>3,5,20,21,24</sup>

The bibliographic material consulted mentions, in 95% that the main failures in vitro studies or short time follow-ups in ceramic materials is due to sensitive characteristics in the conditioning stage of the remaining dental structure, since it focuses on the use of healthy remaining dental tissue at the coronal level, and in the singularities of the pulp chamber, such as its walls and chamber floor, which is where the forces present during the function of the prosthesis are directed. They also mention that the failure of the prosthetic monobloc is related to defects or fractures of the binding agent due to masticatory loads and their direction. <sup>18,19,21,23,24</sup>

It was found that 85% of the articles corresponding to the materials for the elaboration of endocrowns in CAD CAM technology, the most used is IPS e.max, CAD (Ivoclar Vivadent) which contains lithium disilicate, followed by IPS Empress CAD, being a ceramic reinforced with homogeneous leucite particles and VITABLOCKS (Vita Zahnfabrik) in its different presentations for CAD CAM, the latter produced in feldspar ceramics. This type of materials have good behavior in terms of elasticity, flexibility and compressive resistance, with a biofunctional mechanics similar to the underlying dental tissues. <sup>10,11,12,13,23,25</sup>

It is important to highlight that in 15% of the articles studied, the use of ceramics or hybrid resins of the latest generation is mentioned as an effective and long-lived alternative for the manufacture of endocrowns, presenting a success rate similar to ceramic presentations. In this regard, studies suggest research that includes follow-ups on the behavior of this material in the long term, also refer that its use is

primarily recommended in deciduous dental organs. 7.13

**Table 1. Main materials used in the manufacture of CAD/CAM endocrowns**

MATERIAL	MAKER	TRADE NAME
LITHIUM DISILICATE	IVOCLAR VIVADENT	IPS e.max CAD
CERAMIC VITREA REFORZADA WITH LEUCITE	IVOCLAR VIVADENT	IPS Empress CAD
FELDESPATHIC CERAMIC	LIFE ZAHNFABRIK	VITABLOCKS, ESTHETIC LINE, TRILUX
HYBRID CERAMICS	LIFE ZAHNFABRIK	ENAMIC LIFE
HYBRID CERAMICS	3M ESPE	LAVA ULTIMATE
MONOLITHIC ZIRCONIUM	IVOCLAR VIVADENT	IPS e.max ZirCAD Prime

**Table 2. strength and elasticity of the main materials used in the manufacture of CAD/CAM endocrowns**

MATERIAL	FLEXURAL STRENGTH	ELASTIC MODULUS
LITHIUM DISILICATE	360 MPa	62GPa
GLASS CERAMIC REINFORCED WITH LEUCITE	400 MPa	62GPa
FELDESPATHIC CERAMIC	100 A 300 MPa	65GPa
HYBRID CERAMICS	150-160MPa	60GPa
HYBRID CERAMICS	239MPa	60GPa
MONOLITHIC ZIRCONIUM	900-1200MPa	170GPa

The literatures studied show that 97% support the use of this technique in the posterior sector, specifically in molars since the forces in premolars and incisors tend to fracture the restoration and the dental remnant. The selection of cases is conditioned to clinical and anatomical factors of the tooth to be treated such as the coronal cervico-occlusal extension, the integrity or degree of destruction of the coronary remnant, as well as the technique in the preparation or carving. 13,15,19,20,21,23 96% of the articles refer to an important phase in terms of the longevity of the treatment, the correct planning and study of the case prior to preparation, an adequate selection of the system and the adhesive technique in the cementation of the endocrowns. 5,15,20,24

Being a merely adhesive rehabilitation technique, non-traumatic to periodontal tissues, endocrowns were recommended in the literature in more than 90% of the articles, referring to this treatment, arguing a better adaptation to the biological and clinical characteristics of the teeth to be restored; One of the advantages also mentioned is the favorable acceptance by patients to treatment, motivated by the speed between their preparation and cementation when they are manufactured in digital CAD CAM systems, reducing the number of appointments or attentions needed. 8,9,10,15,18,19,26

## 5. Discussion

The technique of rehabilitation of severely compromised teeth with coronal destruction, known as endocrown, using CAD CAM systems, is shown with favorable results in terms of its longevity and biological stability compared to other conventional prosthetic treatments. Spitznagel et al 24 2018, in their research work, highlights the facilities provided by CAD CAM systems for current dental practice,

which translates into substantial benefits in the clinical management of complex restorations, as well as predictable results and greater patient satisfaction with restorative treatments. Subaşı et al 27 in 2018, investigates the long-term optical properties of different materials used in restorative processes with CAD CAM, in their conclusions highlights that the optical characteristics are favorable in all ceramics studied and observed a tolerable stability in the perceived changes in terms of color and its adhesion to the surface studied.

In turn, Hernández<sup>19</sup> in 2016 points out that, due to its great dimensional stability and resistance to fracture when the restoration is presented as a single block, in which the shear, tension and compression forces are distributed, the materials frequently used in the manufacture of the same do not present a significant difference between them.

There is a consensus among the authors Dogui et al; Govare et al; Bettencourt, et al; Aguirre, et al 5,15,16,20 that endocrowns are indicated in endodontically treated molars, with success rates and high longevity, however, in premolar teeth the success rate decreases due to the horizontal forces that support them when subjected during masticatory function.

Govare et al 16 2020, states after a broad review of in vitro and clinical studies that endocrowns are a hopeful alternative in dental organs of the posterior sector, including bicuspid teeth. He maintains like other authors that a critical approach must be taken into account on the information regarding the necessary management protocol for this type of prosthetic component either in pure or hybrid ceramics in order to guarantee the success of the restoration over time.

Dogui, et al<sup>15</sup> in 2018, comments that the adhesion with the materials available today, and taking advantage of the internal anatomy of the pulp

chamber of molars, reduces the need to use a traditional macroretentive approach, preserving in turn, healthy remnant structure that is used as an adjuvant in the distribution of forces once the restorative monoblock is constituted, Cement, remnant structure Therefore, the concept of biointegration and the desired goal of current dentistry of being minimally invasive is achieved.

Aguirre,20 in 2021, maintains that beyond the materials used, the selection of cases and the preparation or adequacy of the dental remnant determine the success of rehabilitation treatments of the endocorona type, which he describes as promising according to the results of his review; he also suggests the need for studies regarding its use in premolars.

Monroy, et al<sup>17</sup> in 2019, using lithium disilicate, after processing by CAD CAM and subjecting it to aging tests, in addition to various compressive tests obtained similar statistical results on average and therefore concludes that there is no significant difference in the use of chamfer preparations in the resistance of the restoration when subjected to compressive forces, It also recommends its use in areas where the final aesthetics are involved.

Foad, et al<sup>13</sup> in 2020, comments that after their research on two preparation designs for endocoronas in premolars, their results do not define a standard that guarantees greater resistance than those commented in the available literature. It is noteworthy that after using a mechatronic chewing simulator and after 5 months of study, simulating intraoral conditions, the restorations made of ceramic infiltrated with polymer VITA ENAMIC (Vita Zahnfabrik) presented greater resistance than the lithium disilicate IPS e.max CAD (Ivoclar Vivadent).

Mora Torres et al<sup>11</sup> in 2020 refers as an alternative material a ceromero for the preparation of endocoronas-type prostheses, this since according to their study it has a good long-term behavior, in terms of an alternative milled in CAD CAM maintains a favorable position towards the use of nanohybrid ceramics.

Kanat-Ertürk, et al<sup>6</sup> in 2018, found after an extensive selection study, and in vitro tests on different materials used as endocoronas, that zirconium presented greater resistance to fracture, however, it is in this type of materials where it evidenced irreparable fractures. The material with the lowest fracture resistance is feldspathic ceramics, where it also finds significant influence given by the depth in the intracamer preparation.

It is crucial to highlight that, at the country level, with Calle-Calle, Cuesta-Nieto<sup>12</sup> in 2021 and Pombosa<sup>25</sup> 2017, a process of recent scientific discussion begins regarding the issue of endocoronas, which influences the relevance and positioning of Ecuador as a scientific producer in the matter. It is necessary to mention that there is a need for clinical studies where long-term follow-ups are carried out on endocoronas manufactured using CAD CAM systems, in order to know the percentage of successes and failures in the

face of fractures and the behavior of commonly used materials.

Finally, it is suggested the search for new research approaches, which allow to expand the evidence and scientific debate regarding the subject of endocoronas assisted by CAD CAM, following updated technological guidelines in modern, current and future dentistry.

## 6. Conclusions

From this literature review it is established that the development in CAD CAM technologies has driven clinical practice on treatments considered invasive in the past to new minimally invasive concepts and with a higher success rate. The endocrowns manufactured in ceramic materials by CAD CAM, constitute an effective resource before the need to restore endodontically treated teeth, ensuring a sealing and marginal adaptation, necessary premise, which also grants to increase the percentage of success on endodontic treatment, because it provides the opportunity to offer a definitive restoration, reducing the time of clinical intervention for its manufacture, thus avoiding contamination of the system of ducts already treated.

It was established that the most used material and with greater stability to forces present in chewing is lithium disilicate, allowing it to be also a good aesthetic alternative in case an endocrown type restoration is required in the anterior sector or in evident aesthetic compromise<sup>28,29,30</sup>. The lithium disilicate used as a restorative material together with an adequate and updated adhesive protocol, provides stability and less risk of fracture and decementation of the endocorona, which allows a long-lasting restoration and less intervention of the tooth effectively ensuring its conservation by behaving better than a conventional restoration that involves physical and mechanical retention.

## References

- Miranda FJP, Quintero SR, Duhalt ID, Rios SE. Endocoronas, a restorative treatment option. *Rev Odont Mex.* [Internet] 2020 [cited: 2021, November];24(3):206-213 Available from: <https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=99682>
- López, N., Solano, L, Guiza, E. Endocoronas a clinical alternative to restore endodontically treated teeth made with CAD/CAM materials. [Internet] [Postgraduate]. Pontificia Universidad Javeriana. 2020. [cited: 2021, November] Available in: <http://hdl.handle.net/10554/51339>
- Tzimas K, Tsiafitsa M, Gerasimou P, Tsitrou E. Endocrown restorations for extensively damaged posterior teeth: clinical performance of three cases. *Restor Dent Endod.* [Internet] 2018 [citado: 2021, noviembre]; 43(4):1–9. Disponible en: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6237728/>
- Taha D, Spintzyk S, Schille C, Sabet A, Wahsh M,

- Salah T, et al. Fracture resistance and failure modes of polymer infiltrated ceramic endocrown restorations with variations in margin design and occlusal thickness. *J Prosthodont Res.* [Internet] 2018 [citado: 2021, noviembre]; 62(3):293–297. Disponible en: <https://pubmed.ncbi.nlm.nih.gov/29241944/>
- Dogui H, Abdelmalek F, Amor A, Douki N. Endocrown: An Alternative Approach for Restoring Endodontically Treated Molars with Large Coronal Destruction. *Case Rep Dent.* [Internet] 2018 [citado: 2021, noviembre]; 2018(46):1–6. Disponible en: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6136487/>
- Kanat-Ertürk B, Sarıdağ S, Köşeler E, Helvacioğlu-Yiğit D, Avcu E, Yildiran-Avcu Y. Fracture strengths of endocrown restorations fabricated with different preparation depths and CAD/CAM materials. *Dent Mater J.* [Internet] 2018 [citado: 2021, noviembre]; 37(2):256–265. Disponible en: <https://pubmed.ncbi.nlm.nih.gov/29311428/>
- Bilgin MS, Erdem A, Tanriver M. CAD/CAM endocrown fabrication from a polymer-infiltrated ceramic network block for primary molar: A case report. *J Clin Pediatr Dent.* [Internet]. 2017 [citado: noviembre, 2021]; 40(4):264–268. Disponible en: <https://pubmed.ncbi.nlm.nih.gov/27471802/>
- Zavanelli AC, Zavanelli RA, Mazaro JVQ, Lemos CAA, Dias ES, Silva EV da, Pinto RC. Endocrown crowns: a literature review and case report. *Arch Health Invest* [Internet]. 2017 [cited: noviembre, 2021]; Available: <https://archhealthinvestigation.com.br/ArchHI/article/view/2215>
- Lima Macêdo K, da Silva T, Silva Y, Pinho L. Endocrown: indications: literature review. *Cathedral Magazine* [Internet]. 2020 [cited: noviembre, 2021]; Disponible: <http://cathedral.ojs.galoa.com.br/index.php/cathedral/article/view/197>
- Poluha RL, Mello Neto CL de, Sábio S. Aesthetic rehabilitation in posterior element: endocrown TT - Aesthetics rehabilitation in a posterior element: endocrown. *Rev Odontol Arac.* [Internet]. 2015 [cited: noviembre, 2021]; 36(1):75–81. Disponible en: <https://pesquisa.bvsalud.org/portal/resource/pt/biblio-857012>
- Mora Torres JA; Jarrín MJ; Dominguez Gaibor DE; Montañó Tatés VA. Endocorona as an alternative to rehabilitate endodontic teeth. Case report. *KIRU.* [Internet]. 2021 [cited: November 2021]; 18(3): 172 - 177. Available in <https://www.aulavirtualusmp.pe/ojs/index.php/Rev-Kiru0/article/view/2181>
- Street-Street N, Cuesta-Nieto E. Endocorona, a different approach in oral rehabilitation. *Scientific Information Journal* [Internet]. 2021 [cited November 2021]; Available: <http://www.revscientificasld.cu/index.php/ric/article/view/3537>
- Foad AM, Hamdy A, el Fatah GA, Aboelfadl A. Influence of CAD/CAM material and preparation design on the long-term fracture resistance of endocrowns restoring maxillary premolars. *Braz Dent Sci.* [Internet]. 2020 [citado: noviembre, 2021]; Disponible: <https://bds.ict.unesp.br/index.php/cob/article/view/2060/4195>
- Silva MSF e, Cruz JH de A, Cristino DL, Rodrigues RA, Sousa JNL de, Monteiro BV de B, Ribeiro RA. Restorative alternative through endocrown: a literature review. *Arch Health Invest* [Internet]. August 26, 2020 [cited noviembre, 2021]; 9(3). Available: <https://www.archhealthinvestigation.com.br/ArchHI/article/view/4712>
- Bettencourt MVM, Ismerim AB, Lima EMCX, Carvalho AO. Endocrown restorations: a literature review. *J Dent Pub H.* [Internet]. 2021 [citado noviembre, 2021]; 12(2):105-114. Disponible en: <https://www5.bahiana.edu.br/index.php/odontologia/article/view/3678/0>
- Govare N, Contrpois M. Endocrowns: A systematic review. *J Prost Dent.* [Internet]. 2020 [cited November, 2021]; 123(3):411-418. Available in: <https://pubmed.ncbi.nlm.nih.gov/31353111/>
- Monroy E, Casañas G. Effect of dental preparation on resistance to compressive forces in lithium disilicate endocoronas. [Internet]. 2019. [cited: November, 2021,] Available in: <http://hdl.handle.net/10554/43189>
- Ormaza FPE, of the VLJ. Comparative study between crowns, endocoronas and endocoronas with absence of an axial wall before tensile forces. *Rev ADM.* [Internet]. 2021 [cited November, 2021]; 78(3):149-154. <https://www.medigraphic.com/cgi-bin/new/resumen.cgi?IDARTICULO=100072>
- Hernandez MA, In vitro study on fracture resistance and type of failure of adhesive fixed prostheses made with different materials and designs [Internet] Universitat Internacional de Catalunya. [Barcelona] 2016 [cited November, 2021]; Available: <http://hdl.handle.net/10803/401337>
- Aguirre Segarra AP, Rodríguez León TC, Abad Salinas YR. Endodontically treated posterior teeth: Alternatives for their rehabilitation based on scientific evidence. Literature review. *RSD* [Internet]. 2021 [citado noviembre 2021]; 10(3) Disponible: <https://rsdjournal.org/index.php/rsd/article/view/13647>
- Alvarez Ibarra Y, Javela ER, Lopez IN, Torres Serrano EJ. Fracture Resistance to Compressive Loads in Endocrown Restorations of Lithium Disilicate with Two Preparation Designs in Upper First Premolars. [Internet] Santo Tomas University. [Bucaramanga] 2021 [cited November, 2021]; Available: <http://hdl.handle.net/11634/33501>
- Della Bona A, Nogueira AD, Pecho OE. Optical properties of CAD-CAM ceramic systems. *J Dent.* [Internet]. 2014 [citado noviembre 2021]; Sep; 42(9):1202-1209. Disponible en: <https://pubmed.ncbi.nlm.nih.gov/25019364/>
- Dartora NR, Maurício Moris IC, Poole SF, Bacchi A, Sousa-Neto MD, Silva- Sousa YT, Gomes EA. Mechanical behavior of endocrowns fabricated with

- different CAD-CAM ceramic systems. *J Prosthet Dent.* [Internet]. 2021 [citado noviembre2021]; Jan;125(1):117-125. Disponible en: <https://pubmed.ncbi.nlm.nih.gov/32057485/>
- Spitznagel FA, Boldt J, Gierthmuehlen PC. CAD/CAM Ceramic Restorative Materials for Natural Teeth. *J Dent Res.* [Internet]. 2018 [citado noviembre 2021] Sep;97(10):1082-1091. Disponible en: <https://pubmed.ncbi.nlm.nih.gov/29906206/>
- Pombose C, Resistance of two unitary prosthetic options in molars; endocoronas and pure porcelain crowns subjected to horizontal forces, comparative study with finite element [Internet] Central University of Ecuador. 2017 [cited November, 2021]; Available: <http://www.dspace.uce.edu.ec/bitstream/25000/10567/1/TUCE-0015-660.pdf>
- Morimoto S, Fraga RM, Tedesco TK, Ozcan M, Sampaio FBWR, Moreira MSNA, Neres Santiago AS, Raggio DP. Procedure time and patient perception for ceramic endocrowns or partial coverage ceramic restorations: a double-blind randomized clinical trial. *Arch Health Invest* [Internet]. 2021 [citado noviembre de 2021];10(4):536-541. Disponible: <https://www.archhealthinvestigation.com.br/ArchI/article/view/5189>
- Subaşı MG, Alp G, Johnston WM, Yilmaz B. Effect of thickness on optical properties of monolithic CAD-CAM ceramics. *J Dent.* [Internet]. 2018 [citado noviembre de 2021];71:38-42. Disponible en: <https://pubmed.ncbi.nlm.nih.gov/29402640/>
- Diego Fabricio Tixi Torres, Carlos Gilberto Rosero Martinez, Ned Vito Quevedo Arnaiz, Jorge Gabriel Del Pozo Carrasco. Limiting Factors of Extenuating Circumstances Using Neutrosophic 2-Tuple (revisited). *Neutrosophic Sets and Systems.* 2022;52:21-28. doi: 10.5281/zenodo.7373321.
- Carmen Marina Méndez Cabrita, Cesar Eduardo Ochoa Díaz, Leonardo Toapanta Jiménez, Mónica Alexandra Salame Ortiz. Success Factors in the Joint Custody Process to Guarantee the Well-being of the Minor Sets. *Neutrosophic Sets and Systems.* 2022;52:29-40. doi: 10.5281/zenodo.7373339.
- Alex Fabián Solano Moreno, Alipio Absalón Cadena Posso, Danilo Rafael Andrade Santamaría, Yanhet Lucía Valverde Torres. Application of Compensatory Fuzzy Logic to a Legal Analysis of Abandonment of Causes. *Neutrosophic Sets and Systems.* 2022;52:41-50. doi: 10.5281/zenodo.7373345.