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Endocrown in Digital: Literature Review

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***Keywords*—Endocrown, Endocrown in digital dentistry, Endocrown CAD CAM, Digital dentistry, Endocrown prostheses.**

***Abstract*— *Currently, with the incessant search for esthetics, new technologies and tissue-conserving materials have emerged, promoting the evolution of adhesive restorations for posterior teeth. Endocrown is a technique created to restore endodontically treated teeth, in which the pulp chamber space is included in the preparation, excluding the need for an intraradicular pin. Prosthetic rehabilitations are more predictable, performed in fewer clinical steps, providing esthetics and longevity through the CAD CAM system. This paper presents a literature review on endocrown restorations in digital dentistry, elucidating concepts, advantages, disadvantages and raising questions about their longevity and adaptation. Articles from PubMed/MedLine, Scholar Google and Google academic from the last 15 years were used, searching for keywords below. It is concluded that the endocrown restorative technique under indication and assiduous evaluation of the clinical case can achieve greater predictability and success, becoming an advantageous alternative, with treatment longevity in the recovery of molar teeth that undergo endodontic interventions, in an aesthetic way and functional.*

I. INTRODUCTION

Digital dentistry has been gaining ground for some time, but in recent years it has become a reality in many offices (HÖLKEN et al., 2022. With CAD/CAM technology (CAD - Computer-aided design and CAM computer-aided manufacturing) there are several advantages for both the patient and the dentist, such as reduced clinical time, fewer clinical steps, as it is a computerized system, it allows standardization and many manual methods such as impression taking, which makes some patients uncomfortable, have been replaced by a scanner. Failures related to adaptation are reduced, which makes the prosthesis longer lasting (PAN et al., 2022).

With the evolution of techniques, thinking about conservative dentistry and the benefits of digital dentistry, “adhesive endodontic crowns”, also called endocrown, have been indicated for their efficiency, aesthetics, function, dental preservation, for understanding the level of clinical complexity in rehabilitation of posterior teeth with great coronal destruction and the effectiveness of these restorations in the face of these treatments (SARATTI et al., 2021).

The advancement of digital dentistry has generated more modern solutions in the dental treatments of patients, providing more predictability, agility, more assertive clinical decisions, and comfort to patients (SCHWENDICKE et al., 2020). CAD/CAM technology makes it possible for endocrown-type restorations to be made in ceramic blocks and machined by the CEREC-CAD CAM system and automated in a single session (GULEC, ULUSOY, 2017).

The present work presents the endocrown type restorations made in a conventional way and with digital technology, correlating the good prognosis that these restorations already have, associating with digital dentistry, being possible to analyze their precision, looking for important characteristics of these restorations with the purpose of to establish the basis for future academic studies that may be of great relevance to dentistry.

Thus, the objective was to understand the benefits and disadvantages of an endocrown-type restoration within digital dentistry when compared to the conventional method. Identifying the longevity of the endocrown in CAD/CAM and when performed conventionally and whether there is a difference in adaptation between the ways of making the endocrown, specifying which method preserves more remaining dental tissue.

II. METHODOLOGY - LITERATURE REVISION

The work was elaborated as a literature review, being considered as a search strategy, articles published in the last 15 years in the databases of PubMed/MedLine, Scholar Google and Google academic. Isolated or combined descriptors will be used, such as: Endocrown, Endocrown in digital dentistry, Endocrown CAD CAM, Digital Dentistry and Endocrown prosthetics, to form the basis of the review.Protese, São Paulo, Brazil) for functional and aesthetic recovery.

Longevity of endocrowns

Rehabilitating endodontically treated teeth with fragility in their structures is a great challenge. With the loss of pulp vitality and the treatment itself, dental tissues undergo structural and biochemical changes and with this reduction of mechanical resistance (MUNIZ et al.,2010).

Most restorative treatments use metallic cast cores, intra-radicular posts that end up further weakening the tooth structure, making it more susceptible to fractures. With the use of endocrowns, it is possible to restore endodontically treated teeth with great coronal destruction, using the entire length of the pulp chamber as a retentive factor (HECK, ARAUJO, 2014).

The first classification of the endocrown, came about by Belleflamme et al. (2017). The classification divides endocrowns into 3 classes, depending on the amount of residual tooth tissue after tooth preparation. The classification was based on the analysis of clinical images and/or cast models by two independent evaluators.

- ✓ Class 1 describes a tooth preparation where at least two cusp walls have a height greater than half the original height (BELLEFLAMME et al., 2017);
- ✓ Class 2 describes a tooth preparation where only one cusp wall has a height greater than half its original height. Class 3 describes a tooth preparation where all cusps and walls are reduced by more than half the original height (BELLEFLAMME et al., 2017).

Indication

The indication for this technique is, therefore, severely compromised posterior teeth, mainly molars, with calcified root canals or very thin roots, inadequate clinical crown length and insufficient interocclusal space, as their interface is sufficient to avoid lever movements (BIACCHi et al., 2013; BORGES JUNIOR et al., 2013; CHANG et al., 2013; ROCCA et al., 2013; ROOPAK et al., 2013). Although molars and premolars anatomically present: short or curved roots, atresias, root obliterations, lacerations, calcified or fragile canals, endocrowns are also the best alternative.

Contraindication

The contraindications of this technique are related to cases in which adherence cannot be ensured (BIACCHI et al., 2013; CHANG et al., 2013; ROOPAK et al., 2013), where the pulp chamber has a depth of less than 3 millimeters or when the cervical margin has a width of less than 2 millimeters in most of the circumference, that is, measures that would impair retention. It is important to remember that the clinical success of the endocrown technique is directly related to all the criteria followed, such as the correct dental preparation, selection of ceramics and manufacturing technology and the choice of cementation material, since the adhesive phase is an important point in this technique.

CAD CAM system and the Endocrown

Advances in adhesive dentistry, computer-aided design, and computer-aided manufacturing (CAD-CAM) technologies, and ceramic materials have resulted in the introduction of new dental restoration systems, including the endocrown restoration, which reduces the risk of failure during post-preparation. intracanal.

Boroudi and Ibraheem (2015) conducted a literature review, which aimed to evaluate the clinical performance of the CAD/CAM system (CEREC and E4D). The authors listed a database of articles available from 2004 to 2014.

The office CAD/CAM system is used in dental restorations, including crowns, inlays, onlays and endocrowns, facilitating the reconstruction of deeply destroyed teeth, regardless of the location of the cavity margins. A scanner is used to convert the tooth preparation into digital information that is processed by software that provides data on the product to be manufactured, and, finally, a milling machine makes the virtual prosthetic structure into reality (RODRIGUES et al., 2021).

Regarding the advantages of the CAD/CAM technique, the authors highlighted: the possibility of providing indirect restorations in the same consultation with precision and satisfactory esthetics; the immediate definitive protection of the tooth without any temporary phase; acceptable marginal fit and clinical longevity. The disadvantages presented were the price of investment and maintenance of the device; the size of the scanning device and milling machine; the concern with the coloring of the piece; dentists' unwillingness to learn a new system and refusal to change their practice.

An in vitro study compared the marginal discrepancy between CAD/CAM-based lithium disilicate crowns with conventional fabrication and found that the marginal accuracy of digital and conventional impressions is similar (ABDEL-AZIM et al., 2015).

According to Papalexopoulos et al. (2021), rehabilitating endodontically treated teeth has always been a challenge and until recently, the fabrication of a full-coverage metal-ceramic or all-ceramic crown together with a metal or fiberglass post has been the "standard". gold" proving its effectiveness through several clinical studies.

With the development of CAD / CAM technology and the evolution of dental materials, new minimally invasive techniques were introduced, with less need for adjustments and less incorporation of structural defects and it has been a reliable alternative to traditional restorative choices, since dentists respect the clinical protocol with steps that must be well executed for a successful restoration, therefore, entirely dependent on the clinical steps, scanning, computer modeling, manufacturing, quality control, material, type of prosthesis and finalization in the laboratory so that you have success in technique (BERNARDES et al., 2012).

Marginal adaptation between the ways of making the endocrown

The long-term clinical success of a ceramic restoration is influenced not only by its mechanical properties, aesthetic qualities, and biocompatibility, but also by its marginal adaptation to the tooth structure, the latter being considered a key criterion in the clinical evaluation of this type of rehabilitation (CONRAD; SEONG; PESUN, 2007).

The marginal adaptation of restorations is an essential feature in their long-term success, that is, neglecting the importance of this factor in restorations with large marginal discrepancies can lead to prospective failure of the prosthesis (SAILER et al., 2007).

In addition, large misfits can contribute to the accumulation of bacterial plaque, and consequently lead to the development of periodontal diseases, or microleakage of the restoration, increasing the risk of caries and endodontic problems (CONTREPOIS et al., 2013). All these alterations, isolated or together, worsen the prognosis of restorative treatment (HABIB; ASIRI; HEFNE, 2014).

Still, there is no consensus on what the maximum clinically acceptable marginal gap width is, ranging from 50 to 200 μm. Previous studies by McLean and Von Fraunhofer (1971), with more than 1000 restorations, concluded that 120 μm can be considered the maximum tolerable marginal gap. Despite the lack of a specific scientific basis, this value is considered the success criterion for most researchers.

Marginal and internal fit can be influenced by many factors, from the impression stage to the final cementation process. Thus, the marginal adaptation and the success of the future restoration are not only influenced, but also directly dependent on the accuracy of the impression, which can be performed using conventional or digital methods (PEDROCHE et al., 2016; SAKORNWIMON; LEEVAILOJ, 2017).

Although high quality impressions are achievable in conventional methods, various errors associated with the intraoral phase, subgingival preparations, presence of blood, spittle or laboratory procedures, disinfection, impression leakage, transport can occur leading to inaccuracies (SAKORNWIMON; LEEVAILOJ, 2017).

On the other hand, digital impressions certainly have proven advantages over conventional impressions, but the accuracy of the fit of the resulting restorations remains questionable in the scientific literature, given that the number of clinical studies evaluating the accuracy of the fit is still limited. Another point to be considered is that there is no consensus as to the ideal limit in ceramic crowns or bridges, which allows for a better marginal adaptation (FREIRE et al., 2017).

Syrek et al. (2010) compared conventional and digital impressions and found a difference of 22 μm between the two impression techniques at the marginal level, 49 μm for digital and 71 μm for silicone impression.

However, studies by Contrepois and collaborators (2013) stated that although there are numerous published studies, in vivo and in vitro, evaluating the marginal adaptation of crowns manufactured with digital and conventional printing, the comparison of these results is not always easy. Thus, they suggested that there is no consensus regarding the method that promotes better results.

Rocca et al. (2015) evaluated the marginal adaptation of endodontically treated molars restored with composite resin endocrown, with or without fiberglass post reinforcement. The results showed that there was no significant difference in marginal adaptation and reinforcement does not have a significant influence.

Studies by Zarauz and collaborators (2015) stated that methodologies vary widely among different studies, making it difficult to directly compare results. In addition, he pointed out that all studies indicated that there was predictable marginal adaptation within or close to the thresholds of clinical acceptability.

According to the data obtained in the clinical study by Berrendero et al. (2016), no statistical differences were found in the fit discrepancy between the crowns made by the two different impression techniques.

Preservation of the dental remnant

Since the evolution of adhesive dentistry, more conservative method choices have been observed, mainly in indirect restorations. Cavity preparations increasingly less invasive and with greater preservation of the tooth structure, being fundamental to establish retention and resistance to displacement of the restoration, regardless of the restorative material and cementing agent. Slightly extruded shape, and internal undercuts must be filled with material to avoid destructive preparations (DIETSCHI, SPREAFICO, 1997; OLIVEIRA, 2012).

Previous studies report that adhesive techniques aim at a more conservative approach, without the need for a more aggressive preparation, since the adhesion provides sufficient retention of the material, preventing loss of healthy dentin tissue, achieving preservation even in cases where there is great destruction. crown, thus, the option of the endocrown technique emerged, allowing coronal restoration through adhesive retention in the pulp chamber in teeth with compromised crowns, without the use of metallic core or prefabricated pins (CARLOS, et al., 2013).

The principles governing the dental preparation for endocrowns follow the same principles for the preparation of indirect restorations of the inlay and onlay type, and can be considered, according to Mezzomo and Suzuki (2006), a selective wear of enamel and/or dentin in shape and extension already determined, with instrumental use in a specific way, so as to create space for an individual restoration. Having slightly extrusive axial walls and a flat pulp chamber bottom, with rounded internal angles, facilitating the subsequent steps in taking the impression, adjustment, cementation and less accumulation of bacterial plaque, the cervical termination must be supra-gingival (FAGES, BENNASAR, 2013; GRESNIGT et al., 2016; MENEZES, SILVA et al., 2016).

According to Papalexopoulos, et al. (2021), endocrowns require a caries-oriented preparation, taking advantage of the adhesion and retention of the walls of the pulp chamber, they are strongly indicated in endodontically treated molars in cases where minimal interocclusal space and curved or narrow root canals are present, and they it must be made of materials that can be bonded to the tooth structure.

The manufacture of this type of prosthetic piece when performed using the CAD-CAM system, ensures that during the design phase there is predictability regarding the cavity preparation, whether there are unevenness and possible correction. Providing results of high compatibility and excellent mechanical properties, allowing aesthetics and function to be returned to the patient.

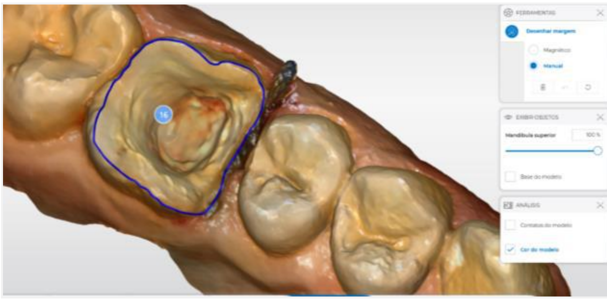

Fig.1 – CEREC preparation margin design.

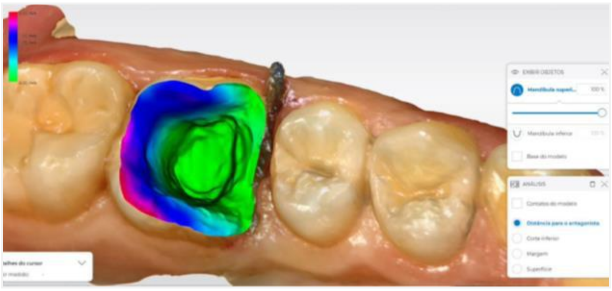

Fig.2 – Analysis of the cavity preparation, indicating the depth level in millimeters in the CEREC software.

III. FINAL CONSIDERATIONS

One of the challenges of the daily clinic is the search for rehabilitation of devitalized dental elements combining aesthetics, resistance, efficiency, speed and durability. Thus, adhesive endodontic crowns emerged as an alternative to the use of intraradicular retainers, as they do not require retention pins, which reduce the wear of the remnant, the maximum load, the weakening of the root canal and the clinical time.

It is well known that endocrown is a technically sensitive, conservative, aesthetic, easy, fast restorative procedure, with very acceptable functionality and longevity, to rehabilitate endodontically treated teeth, mainly molars. However, scientific articles still point out that there is little data on the longevity and success of endocrowns compared to conventional crowns. In view of the above, the endocrown restorative technique under indication and assiduous evaluation of the clinical case, can achieve greater predictability and success, becoming an advantageous alternative, with longevity of treatment in the recovery of molar teeth that undergo endodontic interventions, aesthetically and functional.

IV. CONCLUSION

Clinically, the Index Sensitive technology proved to be efficient in the virtual planning, fabrication, and installation of single-unit prostheses indexed to the post-extraction implant.

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