

Inlay, Onlay: Indication and Principle of Preparation

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ABSTRACT

In the era of tissue preservation, bonded partial restorations such as inlays and onlays are a treatment of choice that meets the major requirements of modern dentistry, thanks to new approaches and new materials.

The objective of this work is to identify, from the scientific literature, the indications and requirements necessary for this type of minimally invasive bonded partial restoration on vital teeth.

Keywords: Minimally Invasive Preparation, Inlay, Onlay, Partial Restorations

Introduction

The so-called “minimally invasive” bonded partial restorations now occupy an essential place in the modern therapeutic arsenal, either to overcome the limitations of direct restorations or, on the contrary, to offer the patient an alternative to coronal-peripheral restorations, which are considered to be more damaging to the dental organ. It will be a question of privileging the most conservative therapies possible while responding to an ever-increasing demand from patients and practitioners in terms of aesthetics and also in terms of durability and longevity.

As a result, the understanding of the importance of tissue preservation and the improvement of biomaterials have made it possible to develop treatment options that better and better meet the biological, biomechanical and esthetic objectives of this so-called “minimalist” dentistry.

Current dentistry is based on the principle of tissue conservation. For the past twenty years, patients have been looking for better and less invasive treatments. The current state of our knowledge allows us today to propose minimally invasive treatments that meet the major requirements of modern dentistry, thanks to new approaches and new materials.

These restorations, particularly inlays and onlays, require a good mastery on the part of the practitioner, a rigorous and difficult preparation and bonding, and their indications remain poorly known. The objective of this work is to identify from the scientific literature the indications and requirements necessary for the prosthetic realization of this type of minimally invasive bonded partial restorations on vital teeth.

Materials and Methods

2-1 Research Strategy

Two literature search strategies, electronic and manual, were employed for this literature review. The informatics search strategy relied on Boolean equations via MESH words pertaining to the topic on PubMed, SCIENCE DIRECT, and GOOGLE SCHOLAR databases.

The Boolean equations used in this work are:

- Dental inlay OR Dental onlay. (Mesh terms)
- Overlay denture AND dental esthetic. (Mesh terms)
- Dental veneer AND ceramic. (Mesh terms)
- Overlay AND dentistry AND esthetics. (Mesh terms)
- Overlay AND ceramic (All field)

The “manual” search strategy took place in the library of the Faculty of Dentistry of Casablanca (FMDC) in the books of the departments: Conjoint prosthesis and biomaterials, journals such as “The journal of prosthetic Dentistry”, theses and residency memoirs.

2-2 Inclusion/exclusion criteria

We retained in this study, all articles published between 2008 and 2018, carried out on human beings and excluded those written in a language other than French and English. (figure 1)

2-3 Critical reading of articles and assessment of methodological quality

The reading of the scientific articles was carried out, on the one hand, by a student in the Faculty of Dentistry of Casablanca (S.E.) and controlled on the other hand, by an associate professor (A.C.) in the service of joint prosthesis of the center of consultation and dental treatment of Casablanca.

Two authors (S.E. and A.C.) independently evaluated the methodological quality of all included articles using the reading grid proposed by the epidemiologist Louis Rachid Salmi.

2-4 Synthesis and Analysis of literature

The article will be valid if the author of the publication:

- Clearly describes a minimally invasive prosthetic treatment and details its protocol and clinical use,
- Develops or compares minimally invasive restorations based on clear and valid criteria such as: preparation design, fabrication material or resistance of the restoration...
- Evaluates the type(s) of minimally invasive restorations based on approved statistical, mechanical and biological tests.

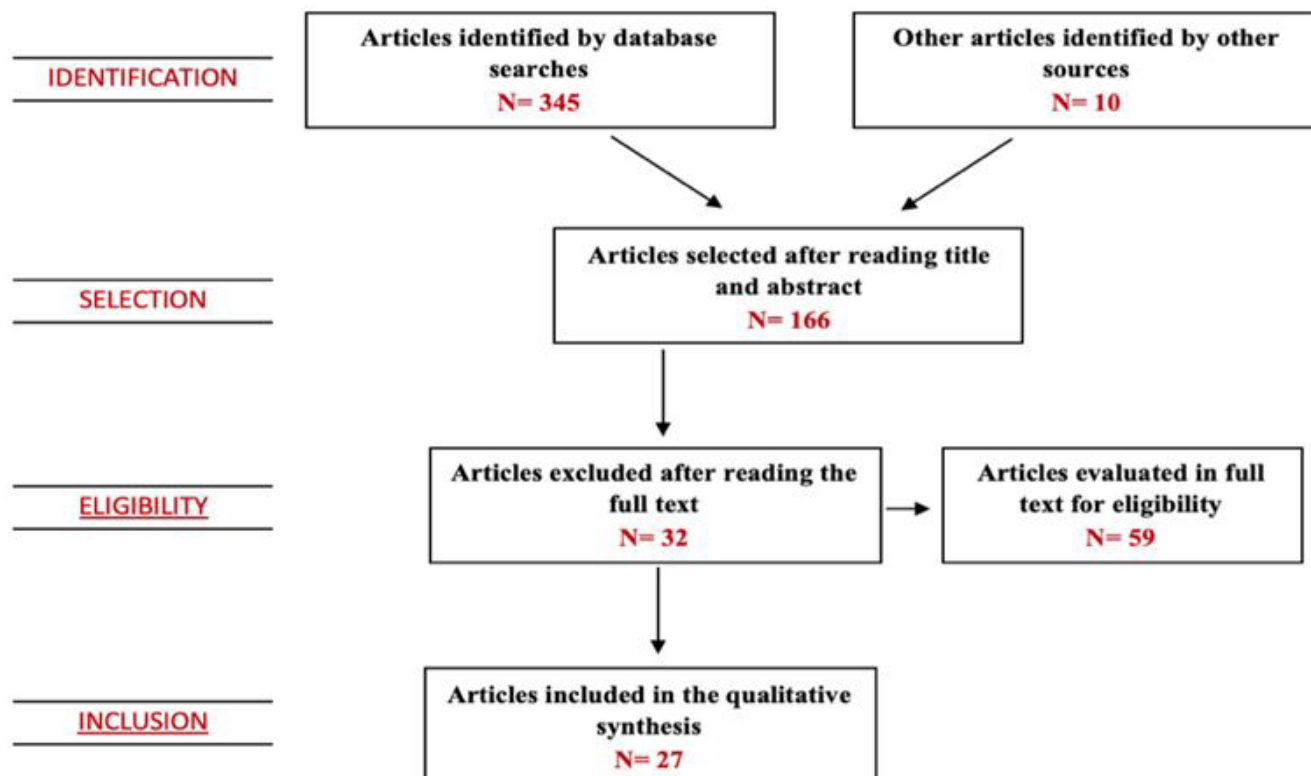


Figure 1: Diagram of the articles selection and identification process

Results

Definition

Inlays-onlays are indirect dental restorations assembled by bonding to restore a loss of tooth substance. Classically, an inlay is described as an incrustation in the tooth without a cuspidian covering. The term onlay is used when the prosthetic part provides a cuspidian covering (11). (Figure 2)

Indications and contraindications

These restorations are indicated for: (1,2,11)

A deep occlusal or occluso-proximal cavity of size 3 or 4 according to the mount-home classification system (damage to one or more cusps, as well as destruction of axial anatomies (vestibular or lingual) by more than one third).

- Endodontically treated teeth in which the cavity has compromised strength and prognosis can be filled with an inlay onlay.
- Replacement of old metal or composite fillings that are unsightly.
- Coronal reconstruction of a tooth with one or more cracks to include it in the restoration, the adhesive technique allowing to

reinforce the natural structures of the tooth. However, the vital prognosis of the tooth should not be at stake and deep vertical mesio-distal cracks for example require a different treatment.

- This type of restoration is very challenging, especially with the bonding step. We can therefore note some contraindications: (1,2,11)
- Unmotivated patients with poor hygiene.
- High cario-susceptibility.
- Difficulty of access to the cavity, which will be a problematic for preparation, impression and cementing under dam.
- A small cavity, e.g. for an inlay, is relatively unsuitable for a ceramic material because it requires a high minimal thickness. A composite material is preferred in this case.

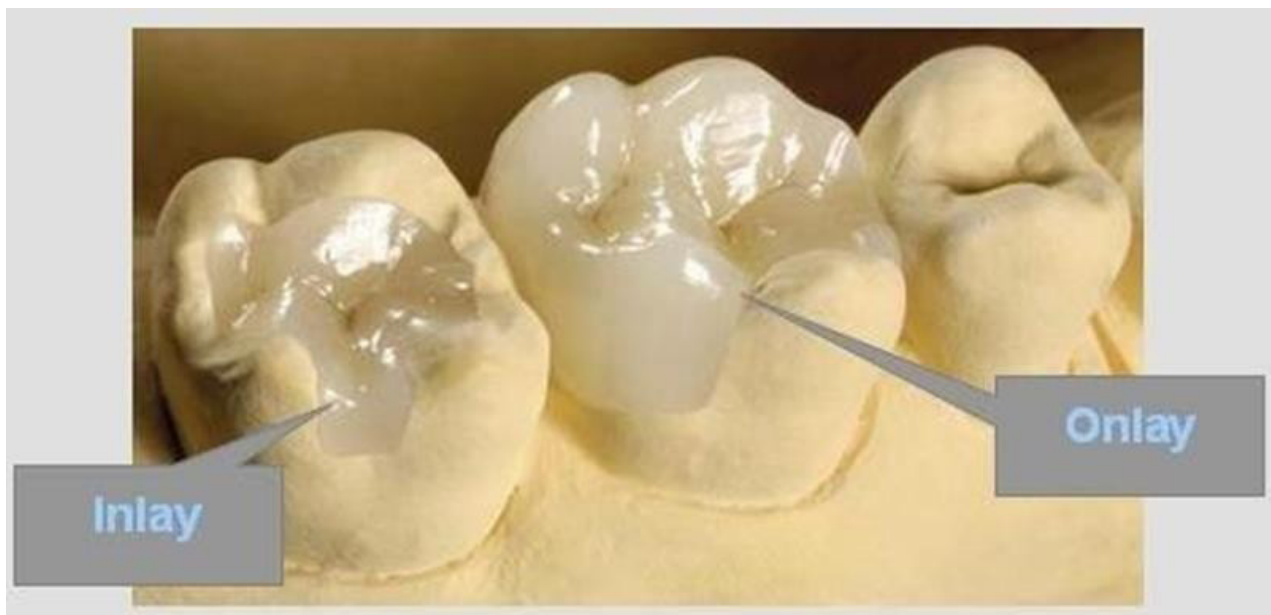


Figure 2: Inlay-onlay (33)

Principles of prosthetic fabrication

The preparation of teeth for ceramic inlays differs from the preparation of metal inlays in that it has axial walls with a taper of about 10° and a very wide isthmus (not less than 2 mm for a molar) with rounded angles.

The occlusal impact points should be located at a distance from the tooth-material joint.

The peripheral finish can be quarter round or right.

It is indicated in case of sufficient depth of the cavity, in the absence of interfering occlusal contacts with an aesthetic rendering superior to the 90° edges. However, the straight finish is generally adopted for mechanical reasons, and ease of realization in the laboratory (12). (Figure 2)

Special considerations for the preparation of teeth for ceramic onlays

The inlay/onlay requires a minimum of 1.5 mm occlusal space and all cuspidian angles must be rounded and the margins must have a shoulder shape with a rounded internal angle or a wide chamfer.

The preparations should have a minimum ceramic thickness of approximately 1.5 mm to 2.5 mm. The cavity can be flat-based if it is deep enough or V-shaped in relation to the central pit to increase the thickness of the restoration for mechanical reasons.

During the second session, the removal of the temporary fillings and the complete cleaning of the cavity are done with an excavator, a probe, a sound or ultrasound insert followed by an air-polishing spray.

The restorative try-in follows the rules for prosthetic restorations (proximal contact point, marginal adaptation, shade, anatomical shape). Occlusal contacts will only be checked after bonding or with the use of a low viscosity silicone to avoid fracture of the element. (12)

Discussion

Ceramic inlay and onlay restorations are now a reliable method of restoring damaged teeth in the posterior region (17).

These ceramic restorations have the advantage of being aesthetically pleasing, offering a variety of colors with stratification possibilities. The esthetic is stable over time and the surface is perfectly polished. The intrinsic properties of ceramics and the precision of the marginal adaptation make these restorations have an excellent biocompatibility. These bonded prosthetic pieces make it possible to restore and improve the bio-mechanical resistance of the tooth/restoration set. (17)

Despite being “fragile” materials, the ceramics used for bonded partial restorations have improved mechanical properties. These materials remain stable over time and allow a functional occlusion with physiological surfaces. Their modulus of elasticity is comparable to that of enamel and this is related to the principle of biomimetics already mentioned (23).

the repair of ceramic restorations is possible with conventional composite resin as long as the bonding protocol on the vitreous ceramic is respected.

There are few studies evaluating laminated feldspathic ceramic inlays-onlays. The results are indicated in the medium term (6 years), which does not allow us to conclude on their clinical performance. For pressed ceramic inlays-onlays, the results are satisfactory with survival rates over 90% at 6 years and over 80% at 12 years. For CAD/CAM* inlays, the results are satisfactory with survival rates of 90% for follow-up times more than 10 years. (22)

The cavity preparations must be done in a rigorous way to minimize the constraints and the fitting of the ceramic pieces must be careful to avoid any fracture of the ceramic.

Because of the risk of fracture, bonded posterior partial restorations are contraindicated in cases of untreated bruxism, although lithium disilicate reinforced ceramics appear to give good short-term results (16).

Due to the hardness of the ceramic, there is a risk of wear of the antagonistic enamel and composite resin restorations.

However, leucite and lithium disilicate reinforced glass-ceramics have a hardness close to that of enamel. This could expand the indication domain of ceramic inlays/onlays.

Like ceramic restorations, laboratory composite restorations have advantages and disadvantages (17) (table 1)

Composite is less fragile than ceramic, absorb more stress, its modulus of elasticity is close to that of dentin and biocompatible.

- The cavity to be made is less disruptive than for a ceramic restoration.
- Their cost is moderate.
- The protocol of execution is simpler than for ceramic restorations.
- There is no risk of wear of the antagonist teeth.
- Repair is easy in the oral cavity.

The aesthetic results are still inferior to those obtained with ceramics, especially with laminated ceramic restorations.

These restorations are more sensitive to exogenous staining.

Despite their improved properties, these restorations have poor resistance to abrasion and masticatory forces.

Factors influencing the choice of a ceramic or composite partial restoration		
	In favor of the ceramics	In favor of the composite
Criteria intrinsic to the restorative tooth	<ul style="list-style-type: none"> • Low number of residual walls (onlay, overlay) • Loss of substance essentially localized in the enamel 	<ul style="list-style-type: none"> • Large number of walls: occlusal and proximal cavity (inlay) • Loss of tooth substance essentially dentin. • Devitalized tooth
Criteria extrinsic to the restorative tooth	<ul style="list-style-type: none"> • Antagonist tooth restored in ceramic • Need to stabilize proximal and occlusal contacts • Allergic terrain • Patient worried about the toxicity of dental materials • Patient with high aesthetic demands 	<ul style="list-style-type: none"> • Antagonist tooth restored in composite • Symptomatic pulped tooth or at risk of endodontic treatment • Potential need for repair, and intra-oral touch-up after bonding • Thin thickness with CAD/CAM shaping

Table 1: Factors influencing material choice

Longevity of inlays-onlays (26)

The factors influencing the longevity of partial restorations can be grouped into 3 major classes:

- patient-related factors
- Practitioner-related factors
- Material-related factors

It is difficult to correlate the influence of these different factors on the longevity of the restorations, but it appears that the factors that cause an early complication of the restoration would be related to the dentist (experience, respect of the indication, dexterity and respect of the clinical procedures) whereas the longer-term complications would be related to the patient and the material.

In their study (26), Weill and al. attempt, through an analysis of the international literature published between 2000 and 2013, to understand the factors influencing longevity in inlay/onlay restorations. It is therefore interesting to analyze these publications in order to compare the different survival rates of composite and ceramic bonded partial restorations.

The study of longevity calls for the analysis of survival rates and success rates, which must be differentiated and defined: **“The success rate:** precisely defined according to specific criteria and respecting a qualitative graduation.

This diversity in the qualification of “success” makes it difficult to compare between studies which do not use the same reference. That’s why the survival rate is considered in these studies.

The Survival rate: indicates the proportion of restorations retained in function without modification (repair, replacement of the restoration or avulsion of the tooth). It does not give any indication of the quality of the restoration in place. (26)

Conclusion

We have been able to recall that posterior bonded partial restorations are an efficient therapeutic option and can be made with different materials, such as composites or ceramics, which lead us to use adhesive techniques. These methods are the beginning of a new dentistry based on tissue economy, biocompatibility, mechanical resistance and aesthetics.

These restorations have several advantages:

- the evolution towards minimal preparations which is less mutilating for the dental organ.
- The filling of undercuts with a dentin substitute which allows to reduce the preparation volume.

- Bonding, which offers a strong adhesion to the dental tissues as well as to the prosthetic substrates, allows a mechanical reinforcement of the tooth and guarantees the durability of the restoration. Biomechanical failures are rare and re-intervention is easy.
- They cause fewer periodontal problems
- They integrate perfectly into the oral environment due to the new aesthetic materials and the possibility of characterization.

In addition, these restorations can be an alternative to coronal-peripheral preparations in depulped teeth. If these teeth have sufficiently strong walls and moderate loss of substance, it is preferable to opt for an inlay/onlay.

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