CASE REPORT

Indirect Posterior Adhesive Restoration: Criteria to Success

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ABSTRACT

Ceramic inlay/onlay is an alternative approach for the restoration of vital posterior teeth with a large cavity while respecting the esthetic, biological, and mechanical imperatives. This approach has been widely used, and various materials and techniques have been reported. However, the success of this type of restoration depends on several factors.A patient presented with esthetic and functional demand. His chief complaint was to replace the overflowing amalgam restoration on the first right mandibular molar. A ceramic onlay was performed using the IPS e.max computer-aided design system and bonded with a resin bonding agent. To succeed in a restoration with ceramic inlay/onlay, it is necessary to know their indications, to respect the guidelines of preparation, to choose the adequate material, and to respect the protocol of bonding.

Key words: Dentin-bonding agents, inlays, lithium-disilicate ceramic, tooth preparation

INTRODUCTION

Ceramic inlays/onlays are currently admitted as a common treatment modality used in contemporary dentistry to restore large areas of decay and to replace old restorations.

Besides with the availability of newer high-strength materials such as lithium disilicate and processing technologies such as computer-aided design/computer-aided manufacturing (CAD/CAM), dental professionals are now able to produce highly esthetic restorations that blend seamlessly with the natural dentition while withstanding posterior occlusal forces. This has resulted in innovative methods of providing minimally invasive dentistry.[1-4]

Adhesive bonding systems are introduced in dental practice not only to improve the retention but also to achieve better esthetic results and to maintain high ceramic strength.[5]

According to recent studies, bonded all-ceramic restorations show a higher fracture resistance than conventionally cemented restorations. This arises from the fact that resin cement used in bonded restorations is elastic and it tends to deform under stress conducting to a higher resistance to fracture. As a consequence when selecting the bonding system, the elastic modulus of the material is of interest.[2]

However, the strict observance of their indications, the choice of materials, the form of preparation adapted to the material, and the mastery of the adhesive techniques determine their success rate and durability.[3,6,7]

This article presents the detailed clinical protocol of this therapy and the factors influencing its success.

CASE REPORT

A 25-year-old male patient with unremarkable medical history, presented to the department of fixed prosthodontics with esthetic and functional demand. His chief complaint was to replace the defective amalgam restoration on the first right mandibular molar [Figure 1].

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A comprehensive clinical examination revealed good hygiene, a defective amalgam restoration on the first right mandibular molar, which caused a papilla inflammation between the 46 and the 47. The vitality test revealed a positive response of the 46.

The radiological examination showed a large-scale amalgam restoration at a distance from the pulp [Figure 2].

After clinical examination, the appropriate treatment option was a ceramic onlay restoring the 46 using the IPS e.max CAD system.

After elimination of the amalgam, the molar was prepared respecting the preparation guidelines for ceramic inlays/onlays:[4]

- The angles between the floor and the axial walls had to be rounded.
- The divergence of the internal walls should not be too limited (≥10°).
- The cavo-superficial boundaries shall be sharp, without bevel.

Figure 1: Defective amalgam restoration on the first right mandibular molar

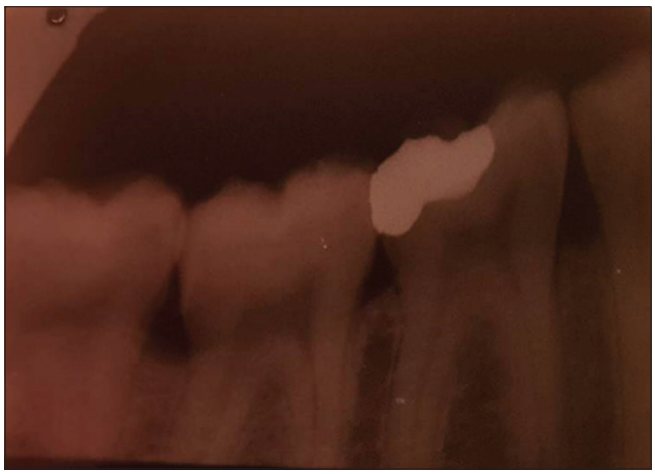

Figure 2: Periapical radiography on the 46: A large-scale amalgam restoration

- Occlusal areas should not be located at the tooth restoration interface.
- The width of the main isthmus should be ≥2 mm.
- The proximal box had to have a mesiodistal width of at least 1 mm.
- The thickness of the restoration had to be of the order of 2 mm at the level of the occlusal groove.
- The width of the residual walls had to be at least 2 mm at the cervical level and 1 mm at the occlusal level.
- The thickness of the restorative materials (composite or ceramic) should be at least 1.5–2 mm at the level of the covered cusps.
- A rounded shoulder is recommended at the level of the covered cusps.

On the buccal surface of the restoration, the margins were located 0.5 mm subgingivally for esthetic reasons and supragingivally on the lingual side. All sharp edges were rounded and smoothed [Figure 3].

After a double gingival cord retraction, a simultaneous double-mixed impression was made using light and heavy silicon A [Figure 4].

Then, working cast was performed and scanned; the onlay was designed referring to the corresponding shade matching, milled by CAD/CAM [Figure 5], and checked intraorally:

Figure 3: Tooth preparation

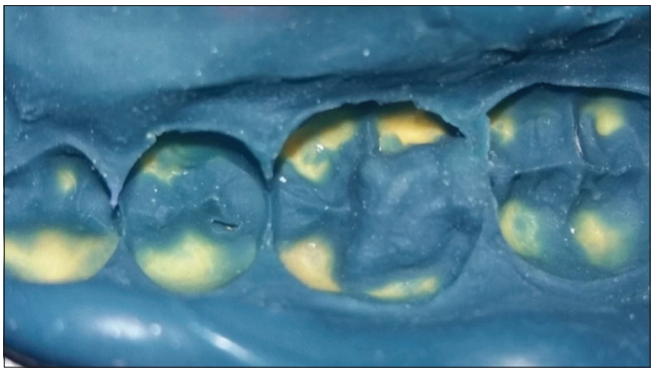

Figure 4: A simultaneous double-mixed master impression

- Proximal contact: Tight surface contact may prevent insertion of the prosthesis or complicate the passage of the floss when removing excess of bonding material. Nevertheless, the absence of contact can cause food impaction, which can cause periodontal diseases.
- Marginal adaptation.
- Esthetics.

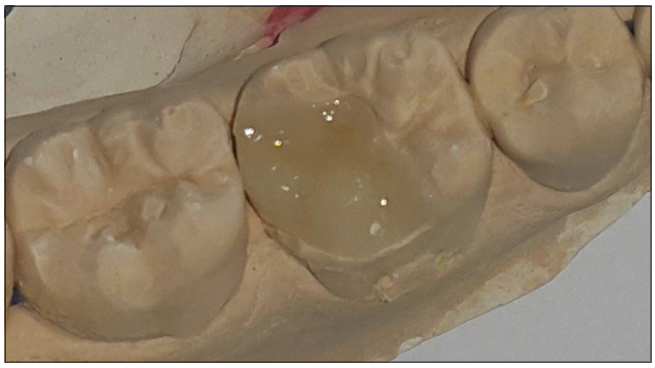

Figure 5: Ceramic inlay/onlay by the system e.max computer- aided design

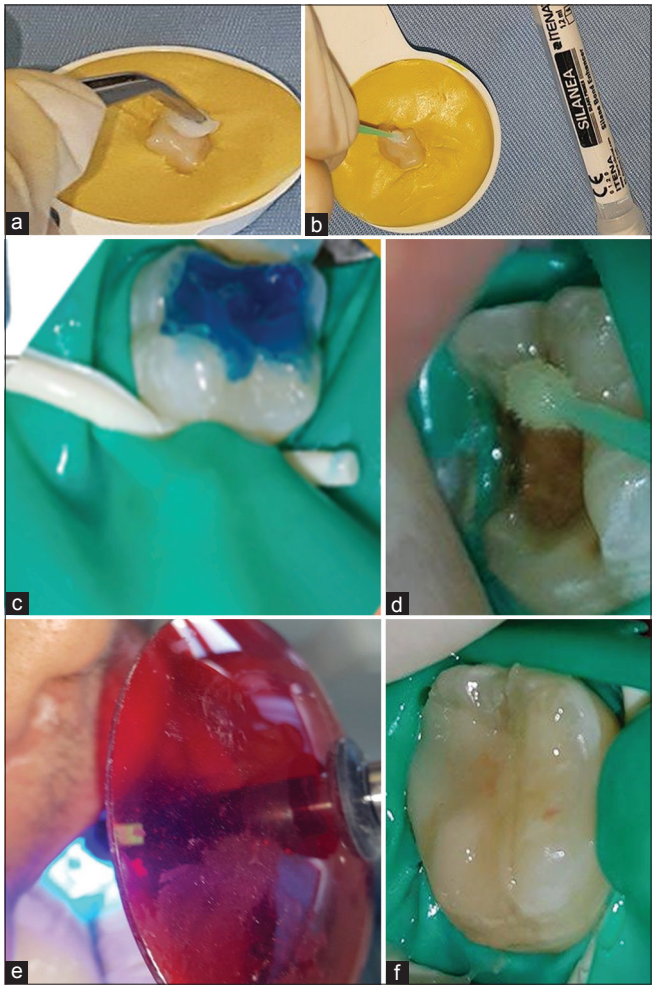

Figure 6: (a-f) Bonding of ceramic onlay

When bonding a ceramic inlay, proper isolation is imperative. The use of a rubber dam is highly recommended.

The preparation is cleaned, rinsed, and dried. The internal surface of the restoration is then etched with hydrofluoric acid during 20 s, after which it is again rinsed and dried [Figure 6a].

A silane coupling agent is applied and allowed to air dry [Figure 6b]. Recommendations for the time of silane application vary from 30 s to 2 min. The chemistry of each system is variable; therefore, following the manufacturer's directions and not mixing products is advisable.

The use of Teflon tape interproximally is a convenient way to protect adjacent teeth. Alternatively, a soft-metal matrix can be used. The tooth surface is prepared as recommended by the manufacturer, with the proper etch, prime, and bond [Figure 6c and d]. Resin bonding agent is then applied to the inlay or the preparation.

The inlay is seated and excess bonding material is removed. The restoration should be supported while the resin is cured [Figure 6e and f].

Gross excess resin can be removed after a spot cure, before completely curing the resin. Light curing is then done in accordance with the resin manufacturer's recommendations. Any residual flash can be removed with a scalpel or suitable

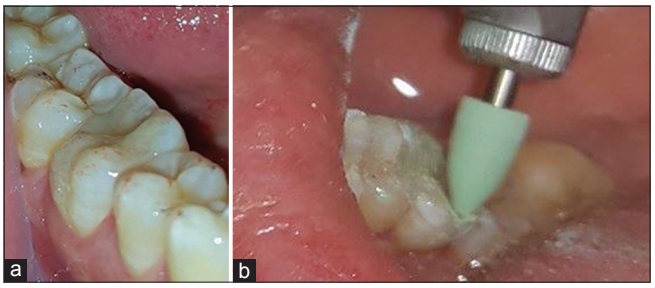

Figure 7: (a and b) Intraoral checking of occlusion

Figure 8: Esthetic and biological integration of the final restoration

curette, but care must be taken not to cause inadvertent deficiencies at the tooth restoration interface.

After which, the occlusion is evaluated and adjusted as necessary [Figure 7a and b]. Any adjusted surfaces can be polished with a suitable polishing system, such as diamond polishing paste or rubber points [Figure 8].

DISCUSSION

According to Hickel and Manhart, the rate of annual failure of a ceramic inlay and onlay varies from 0% to 7.5% for "traditional" ceramics and from 0% to 4.4% for ceramics (CAD/CAM).[8]

The systematic review of Fron Chabouis *et al*. has reported some types of failure:[9]

- Fracture/chipping 4%
- Endodontic complications 3%
- Secondary caries 1%
- Debonding 1%.

To avoid these complications, it is necessary to know the indications of this type of restoration, to choose the ideal material, and finally, to respect the steps of preparation and the bonding protocol.

The study of Hickel and Manhart shows that the annual failure rate of ceramic inlay/onlay (4.4%) is lower than that of direct restorations by amalgam (7%).

Amalgam restorations are characterized by their unnatural appearance which remains a disadvantage. Environmental concerns about mercury and amalgam discharge have resulted in increased externally imposed controls that focus on potential pollution.[7]

Further, it can be used when excellent isolation is problematic, in contrast to the demands of adhesive bonding.

However, achieving proximal contact in an amalgam restoration is straightforward because the material is condensable.

That is why ceramic inlays/onlays find their interest, especially in the following cases:[10]

- A cavity of medium or large extent, stage 3 or 4 of the classification SISTA (Mount and Hume 1998).
- Vital tooth: According to Morimoto *et al*., the chance of failure was 80% less in vital teeth compared with endodontically treated teeth, implying that tooth vitality is a significant factor for restoration survival.[4]
- Loss of a cusp/loss of marginal ridges and contact point.
- Posterior sector where the access is difficult/limitation of mouth opening.

However, in some clinical cases, for example, the presence of parafunction seems to greatly reduce the lifespan of ceramic inlays/onlays, so we should be careful in the indications in bruxomanic patients and advise the wearing of night protective splint.

The study of Dahan and Raux showed that the rate of annual failure of composite inlay/onlays varies from 0% to 10% versus 0% to 5.6% for ceramics inlay/onlays.[10]

According to the study of Yildiz *et al*., reinforced glass ceramics have been used successfully in all-ceramic restorations for >15 years. IPS e.max CAD unites the latest in CAD/CAM processing technologies with a high-performance lithium disilicate glass ceramic material, providing a precise and affordable solution for all-ceramic inlay/onlay. The flexural strength of lithium disilicate glass ceramic (360–400 MPa) is satisfactory for clinical use.[11]

Many studies have shown that, depending on the type of preparation chosen, the stress generated within the material differs. To reduce this stress, preparations for ceramic inlay/onlay must adhere to a number of principles and rules.[3,4]

Ceramic thickness can influence the clinical longevity of all-ceramic restorations. For that, an occlusal tooth reduction of 1.5–2.0 mm provides adequate bulk to maintain the strength of ceramic inlays/onlays with a width of the residual walls of 2 mm at the cervical level and 1 mm at the occlusal level to avoid the dental fracture.

Tooth preparation for indirect bonded restorations can generate significant dentin exposures.

It is recommended to seal these freshly cut dentin surfaces with a dentin bonding agent immediately following tooth preparation, before taking impression.[12]

The American Dental Association states that the thickness of luting cement used to bond a crown should not exceed 40 µm when using different types of luting agents. Although marginal openings in this range are seldom achieved, a 40-µm thickness of the bonding cement is widely acknowledged as the clinical goal.[13]

Therefore, the quality of marginal seal and the thickness of the bonding agent could directly influence the longevity of indirect ceramic restorations. To function effectively, the restoration needs mechanical support provided by the tooth substance, which becomes more crucial in the posterior teeth.

CONCLUSION

Ceramic inlays, by contrast, allow the practitioner to achieve an excellent shade match with surrounding natural tooth

structure. Providing that the appropriate shade is selected and the restoration is fabricated with proper translucency, ceramic inlays can be almost indistinguishable from the tooth being restored. They have improved physical properties in comparison to direct posterior composite resin restorations, and when preparation margins are situated in enamel, ceramic inlays offer the potential of reduced microleakage by comparison to either amalgam.

Hence, to succeed in a ceramic inlay/onlay, it is necessary:

- To know their indications
- To respect the principles of preparation
- To choose the adequate material
- To respect the protocol of bonding.

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