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Material selection for partial bonded restorations

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Abstract:

Introduction:
The shift towards minimally invasive dentistry has made partial posterior restorations a cornerstone of contemporary practice. However, the success of these adhesive restorations is highly dependent on the appropriate selection of restorative materials. With a wide array of options available clinicians face a complex decision that must balance aesthetic demands, functional requirements, and biomechanical properties.

Observation:
This paper aims to provide a clear, clinically-focused framework for selecting the optimal material for partial posterior restorations. It will synthesize evidence-based principles to guide the choice between direct composite, CAD/CAM composite, feldspathic porcelain, lithium disilicate, and resin-matrix ceramics based on specific clinical scenarios.

Discussion:
The discussion will provide a comparative analysis of materials through the lens of key clinical selection criteria: Cuspal coverage, the condition of the surrounding tooth structure, esthetic requirements, pulpal health, restoration thickness, potential for repair or re-intervention

Keywords: Partial bonded restorations, minimally invasive dentistry, Adhesive techniques, Material selection, ceramic classification, clinical cases

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Introduction:

The preservation of dental tissues has become a central objective in modern restorative dentistry. Advances in adhesive techniques and high-performance materials have enabled clinicians to move away from traditional full-coverage crowns toward more conservative options, such as partial bonded restorations.

However, the clinical success of partial restorations depends largely on the appropriate selection of restorative materials. Each option—direct composites, CAD/CAM composites, feldspathic porcelain, lithium disilicate, or resin-matrix ceramics—presents specific advantages and limitations. Choosing the most suitable material requires balancing esthetic demands, mechanical performance, functional requirements, and the clinical situation of the patient.

This paper presents two clinical cases that highlight the decision-making process behind material selection for partial bonded restorations and discusses the criteria that guide the clinician in achieving predictable and durable outcomes.

Observation:

Clinical case 1:

Our first case involves a 35-year-old patient, with an upper first molar that presents a defective amalgam restoration.

The treatment began with the removal of the amalgam and the excavation of residual carious tissue (Fig 1) and (Fig 2).

Fig 1 : Initial state

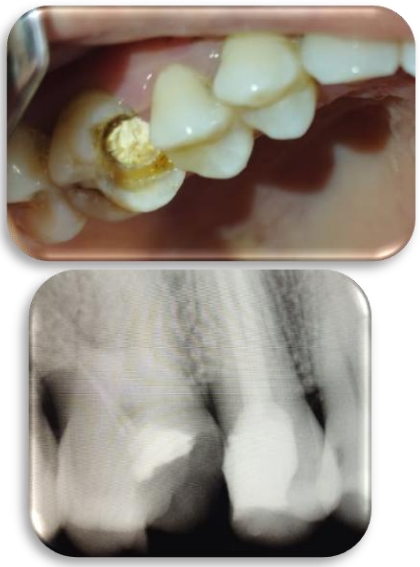

Fig 2 : Amalgame removal and periapical radiograph

The final preparation revealed a cavity extending into the dentin, while preserving a substantial and clearly defined amount of residual enamel (Fig 3).

✓ These parameters guided our therapeutic decision toward a lithium disilicate–reinforced glass-ceramic overlay.

To ensure optimal biomechanics, it is crucial to maintain uniform ceramic thickness across the restoration. For this reason, a build-up was carried out using flowable and conventional composite resin (Fig 4), providing the necessary support and stability for the overlay.

Fig 3: Residual carious tissue excavation

Fig 4: Build up
(Flowable resin + composite resin)

Fig 5: adaptation of the provisional prosthesis

Fig 6: Final result

Clinical case 2:

For our second clinical case, it's about a 43-year-old patient, complains about a defective coronal obturation with CVI, we start with the initial diagnosis, followed by the excavation of residual carious tissue (Fig 1) and (Fig 2).

After occlusal preparation and margin refinement (Fig 3), a rubber dam is placed to ensure isolation (Fig 4). Deep margin elevation is then performed to optimize bonding conditions (Fig 5). And a provisional prosthesis is placed (Fig 6).

After verifying the occlusal contact points, we proceed with the final preparation, ensuring optimal fit and precision (Fig7).

✓ In this case, the therapeutic decision was to use a hybrid ceramic inlay-onlay, specifically a resin nanoceramic, which combines aesthetic qualities with favorable mechanical properties (Fig 8).

Fig 1: Initial state

Fig 2: Residual carious tissue excavation

Fig 3: occlusal preparation

Fig 4: Rubber dam in place

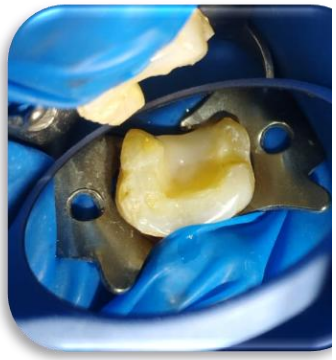

Fig 5: deep margin elevation

Fig 6:Provisional prosthesis

Fig 7: verifying the occlusal contact points

Fig 8: Final result

Discussion:

I. The evolution of dental ceramics:

The evolution of dental ceramics has been fundamentally driven by the need to overcome the intrinsic brittleness and low fracture strength of early feldspathic porcelains.

The initial paradigm shift occurred with the introduction of reinforcing crystalline phases, such as **leucite** and subsequently **lithium disilicate** (e.g., IPS e.max), which significantly enhanced mechanical properties and expanded indications to include bonded anterior veneers and posterior partial coverage restorations.

A further innovation materialized with the development of **resin-matrix ceramics** (e.g., VITA Enamic), which feature an interpenetrating network of ceramic and polymer. This hybrid structure aims to combine the wear resistance of ceramic with the resilience and machinability of composite resins, making them particularly suitable for inlays and onlays.

For the most demanding applications requiring exceptional strength, such as endocrowns on endodontically treated teeth, **zirconia-reinforced ceramics** have emerged as the material of choice, offering a combination of high fracture toughness, satisfactory bondability, and superior aesthetics.

This trajectory from feldspathic porcelain to advanced zirconia composites illustrates a clear material science principle: the strategic integration of different phases and compositions is key to tailoring mechanical and optical properties for specific clinical scenarios.

II. Indications of posterior partial bonded restorations:

The principal indications for posterior partial bonded restorations are well-defined by specific clinical parameters. These include the presence of a large Class II cavity, a severely compromised interproximal zone, an isthmus width exceeding one-third of the occlusal width, or the need to reconstruct one or more cusps.

However, the mere presence of an indication does not singularly dictate the material of choice.

The selection process is a multifactorial decision, requiring a simultaneous assessment of several key parameters;

- The required degree of cuspal coverage
- The final restoration thickness
- The pulpal status of the tooth
- The specific restoration environment (including occlusal forces and antagonistic contacts)
- The patient's aesthetic requirements
- The material capacity of repair or reintervention

must all be weighed against the mechanical and optical properties of available materials. Therefore, a successful outcome is not achieved by simply matching an indication to a material, but by navigating a decision matrix where the clinical circumstances dictate the necessary material properties.

1. Cuspal coverage:

The relationship between design and material performance is critical. **The greater the cuspal coverage, the lower the restoration's fracture resistance** (1) :

Inlays: Nanoceramic resin > Lithium disilicate ceramic > Composite / Leucite-reinforced ceramic

Onlays: Lithium disilicate ceramic + Dual-cure resin > Nanoceramic resin > Feldspathic ceramic

Overlays: Leucite-reinforced ceramic > Composite > Feldspathic ceramic

For a conservative inlay, a nanoceramic resin may be an excellent choice, while an onlay requirs significant strength that demands the superior performance of lithium disilicate ceramic (2) .

➔ So, what is optimal for an inlay is not necessarily suitable for an overlay.

2. Restoration thickness:

Concerning the Restoration’s Thickness, the fabrication of table tops or minimally invasive restorations is possible with ceramics.

In contrast, milled composite resin onlays and overlays exhibit more cohesive fractures of the material, necessitating greater thickness, which, unfortunately weakens its bonding capacity (3) .

Nevertheless, as we have explained, ceramic performs better when the surface to be covered is primarily enamel.

3. Pulp status:

The pulp status makes no difference in our choice, so endodontically treated or not it’s the same,

However, it’s all about the structural integrity of a tooth, when a tooth has lost critical structures like both marginal ridges, its fracture risk is high (6).

4. Restoration's environment:

The type of tooth does not appear to affect the survival rate (2), but composite inlays perform significantly better on premolars than on molars (5).

For Bruxism cases, the survival rate of partial bonded posterior restorations is clearly lower. therefore, it's recommended to choose ceramic veneers in the anterior zone, and reinforced ceramic overlays for posterior zones. Ofc with a bruxism mouthguard to protect our restorations from the excessive forces (2).

For the opposing tooth, when there are areas of exposed **dentin**, it seems preferable to use bonded milled composite, whereas against **enamel** surfaces, ceramic appears to be a better compromise (3).

In conclusion, the choice of the **restoration material's rigidity** depends on the **rigidity of the substrate**.

5. Aesthetic requirements:

Our decision-making extends beyond mere mechanics; we must also address aesthetic demands.

Ceramics are the material of choice here, offering superior aesthetics, more predictable aging, and less plaque retention than composite resin, ensuring that both beauty and periodontal health are maintained (6).

6. Capacity of repair or reintervention:

In the event of a restoration fracture, we can face four options:

- No intervention
- Polishing
- Repair
- Replacement

✓ Adjustments, polishing, or repairs are simpler on restorations made of composite resin than on ceramic, representing one of the major advantages of these materials (7) .

Conclusion :

Partial bonded restorations represent a reliable and biomimetic alternative to conventional full-coverage crowns. Their success relies on both the clinician's ability to follow strict adhesive protocols and the judicious selection of restorative materials adapted to each clinical situation. Lithium disilicate, hybrid ceramics, and resin-matrix ceramics have expanded the range of possibilities by offering a combination of strength, esthetics, and conservation of dental tissues. The presented cases illustrate how an evidence-based material selection process can optimize both function and esthetics while ensuring long-term success.

Future perspectives in digital dentistry and material development will continue to refine the clinical indications of partial bonded restorations, reinforcing their role as a cornerstone of minimally invasive dentistry.

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