Clinical Strategies for Tooth Structure Preservation Using Bonding Systems and Diverse Restorative Materials: Case Series

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Introduction

Composite resins and adhesive bonding systems have become essential components of contemporary restorative dentistry. Modern adhesive techniques allow clinicians to preserve sound tooth structure while improving esthetics, function, and long-term prognosis. In addition to direct resin restorations, adhesive protocols are now widely integrated with ceramic restorations and indirect metal restorations. This presentation focuses on minimally invasive restorative strategies using different restorative materials and material-specific bonding protocols for tooth structure preservation and maintenance of pulp vitality.

Materials and Methods

Several clinical cases utilizing contemporary adhesive restorative approaches were presented.

For diastema closure, phosphoric acid etching was performed followed by the application of *Clearfil SE Bond* adhesive system and restoration with *Beautifil Flow Plus* flowable resin, achieving favorable esthetic integration with a minimally invasive approach.

A single case of vital pulp therapy using composite resin and bioceramic materials to preserve pulp vitality. The initial extensive composite restoration failed after 3 years due to its large restoration volume; however, pulp vitality remained intact. The tooth was subsequently restored with a lithium disilicate ceramic restoration. The ceramic surface was treated with hydrofluoric acid and silane application, and bonded using *OptiBond™ FL*. The tooth structure was also conditioned with *OptiBond™ FL*, and a high-filler flowable resin composite was used as the luting agent to complete a conservative, tooth-preserving restoration.

Root caries cases were restored using *3M™ Single Bond Universal Adhesive* in combination with *3M™ Filtek™ Flowable Restorative* and *Filtek™ Z250 Universal Restorative*. Long-term clinical follow-up demonstrated stable restorative performance for up to 10 years.

For indirect gold restorations, adhesive cementation protocols using *Tokuyama Universal Bond* with a noble metal primer were applied. Conservative preparation designs, including partial crown and onlay restorations, were selected to maximize preservation of remaining tooth structure.

Results

The cases demonstrated successful outcomes using adhesive restorative approaches, including diastema closure, vital pulp therapy, root caries management, and adhesive cementation of gold restorations. Overall, favorable esthetics, function, pulp vitality preservation, and long-term tooth structure stability were achieved, with up to 10-year follow-up showing stable results in root caries cases.

Conclusion

Modern adhesive dentistry enables predictable, minimally invasive treatment across a wide range of restorative conditions. Successful outcomes depend on appropriate use of composite resins, bonding systems, and material-specific surface treatments. The integration of composites, ceramics, bioceramics, and adhesive cementation of metal restorations supports long-term preservation of tooth structure, biological health, and function.

The effects of low-dose 2-hydroxyethyl methacrylate and 10-ethacryloyloxydecyl dihydrogen phosphate on cell viability in human dental pulp stem cells

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I. Objective
The purpose of this study was to evaluate the growth of cells in different concentrations of following functional monomers used in dental adhesives: 10-Methacryloyloxydecyl dihydrogen phosphate (10- MDP) and 2-hydroxyethyl methacrylate (HEMA).
II. Materials & Methods
The cell line used for cell viability assessment was human dental pulp stem cells (DPSCs) isolated from extracted human teeth. The functional monomers, 10-MDP and HEMA, were diluted in dimethyl sulfoxide (DMSO) at concentrations ranging from 25 to 500 μM. DPSCs which were cultured in medium without monomer solution was control groups. The DPSCs were seeded into 96-well plates and allowed to attach for 24h. Subsequently, the cells were exposed to 10-MDP and HEMA for 1, 4, 7, 10, 14 and 21 days. The cell viability was assessed using Alamar Blue assay. The data were analyzed using one-way ANOVA and Tukey's post-hoc test.
III. Results
Regardless of the concentration and type of functional monomers, no significant differences in cell viability were observed among the groups at the early stages of the experiment (Days 1, 4 and 7) ($p > 0.05$). Although minor variations were detected at Day 10, the majority of experimental groups remained statistically comparable to the control group.
However, at Day 14, significant differences in cell viability began to emerge among the experimental groups ($p < 0.05$). Compared with the control group, the 10-MDP-only group (Group D, 200 μM 10-MDP) and the combined group treated with 375 μM HEMA + 125 μM 10-MDP (Group F) showed a trend toward lower cell viability, indicating the onset of time-dependent cytotoxic effects.
On Day 21, the differences in cell viability among the groups became more pronounced. The control group and low-concentration experimental groups maintained significantly higher cell viability, whereas Group D (200 μM 10-MDP) and the combined treatment groups F (375 μM HEMA + 125 μM 10-MDP), G (500 μM HEMA + 125 μM 10-MDP), and H (500 μM HEMA + 200 μM 10-MDP) exhibited significantly reduced cell viability compared with the control group ($p < 0.05$), demonstrating a clear time- and concentration-dependent cytotoxic response.
IV. Conclusion
This study investigated the effects of 10-MDP and HEMA on cell viability of DPSCs in order to simulate the cellular responses of cells in clinically relevant concentration. No significant differences in cell viability were observed during the early stages of the experiment (Days 1, 4, 7 and 10). However, on Day 14, the control group showed significantly higher cell viability than several experimental groups. On Day 21, higher concentrations of HEMA and/or 10-MDP resulted in a significant reduction in cell viability. These findings highlight the time- and concentration-dependent cytotoxicity of these functional monomers in DPSCs.

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