

Preparation and Filling of a Black Class 3 Carious Cavity

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Abstract

Black Class 3 carious lesions represent defects localized on proximal surfaces of anterior teeth without involvement of the incisal angle and remain an important clinical problem in restorative dentistry due to aesthetic, functional, and structural complications. Successful treatment requires precise cavity preparation, effective elimination of infected tissues, preservation of healthy dental structures, and appropriate restorative filling techniques ensuring long-term functional and aesthetic outcomes. This study investigates clinical principles of preparation and filling of Black Class 3 carious cavities with emphasis on cavity design, adhesive protocols, restorative materials, isolation techniques, anatomical reconstruction, polymerization methods, and prevention of secondary caries. The findings demonstrate that minimally invasive preparation combined with modern adhesive composite restoration significantly improves marginal adaptation, structural durability, aesthetic integration, and patient satisfaction. Contemporary restorative approaches emphasizing preservation of enamel and dentin integrity contribute substantially to optimization of treatment outcomes and prevention of recurrent carious destruction. Preparation and restoration of Black Class 3 carious cavities remain among the most significant procedures in modern restorative dentistry because lesions localized on proximal surfaces of anterior teeth directly affect aesthetics, phonetics, mastication, and structural integrity of dental tissues. Black Class 3 lesions develop primarily as a consequence of bacterial plaque accumulation, carbohydrate fermentation, acid-mediated enamel demineralization, and progressive destruction of dentin structures within interproximal regions of anterior teeth. Successful treatment requires comprehensive elimination of infected tissues, preservation of healthy enamel and dentin, restoration of proximal anatomy, and achievement of long-term adhesive stability. This study presents an expanded analysis of operative preparation and filling techniques for Black Class 3 carious cavities with particular emphasis on minimally invasive cavity design, adhesive protocols, composite resin restoration, polymerization methods, contour reconstruction, and prevention of secondary carious lesions. The findings demonstrate that contemporary adhesive restorative systems significantly improve mechanical retention, marginal adaptation, color integration, anatomical morphology, and long-term clinical durability of restorations. Minimally invasive preparation combined with modern composite technology contributes substantially to preservation of tooth vitality, improvement of oral aesthetics, and enhancement of functional rehabilitation in anterior dental regions.

Keywords: Black Class 3 cavity, dental caries, restorative dentistry, composite restoration, cavity preparation, adhesive systems, anterior teeth, aesthetic dentistry, resin composite, minimally invasive dentistry

1. Introduction

Dental caries remains one of the most распространённых chronic diseases affecting oral health worldwide and represents a major cause of structural destruction of dental tissues, functional impairment, and aesthetic disturbances. Black Class 3 carious lesions involve proximal surfaces of anterior teeth without affecting the incisal edge and are frequently associated with plaque accumulation, inadequate oral hygiene, carbohydrate-rich nutrition, enamel demineralization, bacterial acid production, and reduced resistance of dental hard tissues. Due to localization within aesthetically important regions of the oral cavity, treatment of Class 3 cavities requires not only elimination of pathological tissue but also restoration of natural tooth morphology, translucency, color harmony, and functional occlusion. Contemporary restorative dentistry increasingly emphasizes minimally invasive principles aimed at maximal preservation of healthy enamel and dentin structures while ensuring complete removal of infected carious tissue and prevention of secondary bacterial contamination. Preparation of Class 3 cavities requires careful access formation, elimination of unsupported enamel, preservation of marginal ridges where possible, and creation of cavity contours supporting optimal retention and adhesive bonding. Modern adhesive dentistry has significantly transformed restorative treatment through development of composite resin materials, advanced bonding systems, and polymerization technologies providing excellent mechanical properties and superior aesthetic outcomes. Composite restorations offer advantages including conservative cavity preparation, chemical and micromechanical adhesion, color stability, translucency, and restoration of natural tooth anatomy. Successful treatment additionally depends on effective isolation from saliva contamination, accurate shade selection, proper matrix adaptation, incremental filling techniques, and adequate light polymerization ensuring dimensional stability and reduction of polymerization shrinkage stress. Inadequate preparation or restorative technique may lead to marginal leakage, discoloration, postoperative sensitivity, recurrent caries, restoration fracture, and periodontal complications. Contemporary restorative protocols therefore require comprehensive understanding of dental anatomy, cariology, biomaterials science, adhesive chemistry, and clinical operative techniques to achieve predictable long-term therapeutic success and preservation of oral health. Dental caries continues to represent one of the most widespread chronic pathological conditions affecting the oral cavity and remains a major cause of structural destruction of hard dental tissues worldwide. Black Class 3 carious lesions involve proximal surfaces of anterior teeth without extension into the incisal angle and are frequently associated with inadequate oral hygiene, bacterial plaque accumulation, frequent carbohydrate consumption, salivary imbalance, enamel demineralization, and reduced resistance of dental tissues to acidic metabolic products generated by oral microorganisms. Because anterior teeth play a central role in facial aesthetics, phonetic articulation, and psychological self-confidence, restoration of Class 3 cavities requires not only elimination of pathological tissues but also precise reconstruction of natural tooth morphology, translucency, contour, texture, and color harmony. Modern restorative dentistry increasingly emphasizes minimally invasive therapeutic concepts focused on maximal preservation of healthy enamel and dentin structures while ensuring complete removal of infected tissues and prevention of recurrent bacterial contamination. Preparation of Class 3 cavities requires careful formation of operative access, elimination of unsupported enamel prisms, preservation of structurally stable dental tissues, and optimization of cavity geometry for adhesive retention and stress distribution. Technological advancement in adhesive dentistry has significantly transformed treatment approaches through development of highly aesthetic resin composite materials, advanced bonding systems, nanotechnology-based restorative materials, and improved polymerization protocols. Composite restorations demonstrate excellent optical characteristics, mechanical durability, biocompatibility, and micromechanical adhesion allowing restoration of natural anatomical appearance with minimal sacrifice of intact tooth structure. Successful restorative treatment additionally depends on proper isolation techniques, precise shade selection, controlled matrix adaptation, incremental composite placement, and adequate photopolymerization reducing polymerization shrinkage and marginal stress formation. Improper cavity preparation, inadequate isolation, insufficient bonding, or poor contour reconstruction may result in microleakage, restoration discoloration, postoperative hypersensitivity, secondary caries formation, periodontal irritation, and restoration fracture. Contemporary operative dentistry therefore requires comprehensive understanding of cariology, dental anatomy, biomaterials science, adhesive chemistry, and aesthetic reconstruction principles to achieve predictable long-term clinical success and maintenance of oral health.

2. Materials and Methods

This study was conducted using clinical and laboratory analysis of restorative treatment approaches for Black Class 3 carious cavities performed between 2020 and 2025. Patients with proximal carious lesions of anterior teeth underwent comprehensive dental examination including visual inspection, radiographic evaluation, caries activity assessment, pulp vitality testing, periodontal evaluation, and occlusal analysis. Clinical procedures involved local anesthesia where indicated, rubber dam isolation, cavity preparation using high-speed and low-speed rotary instruments, removal of infected dentin, and preservation of healthy tooth structures according to minimally invasive principles. Enamel beveling techniques were applied to improve adhesive surface area and aesthetic blending of restorative material. Adhesive protocols included acid etching, primer application, bonding systems, and incremental placement of light-cured composite resin materials. Matrix systems and transparent wedges were utilized to restore proximal contour and contact points. Polymerization was performed using LED curing units according to manufacturer recommendations. Finishing and polishing procedures included contour refinement, occlusal adjustment, surface smoothing, and polishing to optimize aesthetics and plaque resistance. Clinical evaluation assessed marginal adaptation, anatomical reconstruction, postoperative sensitivity, restoration integrity, color stability, gingival response, and patient satisfaction during follow-up observation.

3. Results

Clinical evaluation demonstrated that minimally invasive preparation and adhesive composite restoration provided highly effective treatment outcomes for Black Class 3 carious cavities. Preservation of healthy enamel and dentin structures contributed to improved tooth strength and reduction of unnecessary tissue loss. Rubber dam isolation significantly improved adhesive bond quality by preventing salivary contamination during restorative procedures. Enamel beveling increased surface area for bonding and enhanced aesthetic integration between composite material and natural tooth structure. Incremental placement of composite resin reduced polymerization shrinkage stress and improved marginal adaptation and structural stability of restorations. Modern adhesive systems demonstrated strong micromechanical retention and effective sealing of dentinal tubules, thereby reducing postoperative sensitivity and microleakage. Restorations exhibited satisfactory anatomical contour, color harmony, translucency, and surface smoothness closely resembling natural anterior teeth. Follow-up examination demonstrated low incidence of marginal discoloration, recurrent caries, restoration fracture, and periodontal irritation when appropriate clinical protocols were followed. Patients reported significant improvement in aesthetics, masticatory comfort, phonetics, and overall oral health satisfaction following restorative treatment. Inadequate isolation, improper adhesive application, and insufficient polymerization were identified as major factors associated with marginal leakage, restoration failure, and postoperative complications. Clinical and restorative evaluation demonstrated that minimally invasive preparation combined with adhesive composite restoration provided highly effective treatment outcomes in management of Black Class 3 carious lesions. Conservative removal of infected dentin while preserving healthy enamel significantly improved structural integrity and biomechanical resistance of restored teeth. Rubber dam isolation effectively prevented contamination by saliva and gingival fluids, thereby enhancing adhesive bond strength and marginal sealing capacity of restorative materials. Enamel beveling increased bonding surface area and improved optical blending between composite material and natural enamel structures, contributing to superior aesthetic integration. Incremental placement of composite resin materials significantly reduced polymerization shrinkage stress and improved adaptation to cavity walls, minimizing formation of marginal gaps and microleakage. Modern adhesive systems demonstrated high bond durability and efficient sealing of dentinal tubules resulting in reduced postoperative sensitivity and improved restoration longevity. Restorations exhibited satisfactory proximal contour, anatomical morphology, contact point reconstruction, translucency, and color stability closely resembling natural anterior teeth. Follow-up clinical examination revealed low incidence of recurrent caries, marginal discoloration, restoration fracture, gingival inflammation, and occlusal discomfort when standardized restorative protocols were correctly followed. Patients reported significant improvement in dental aesthetics, phonetic function, psychological confidence, and overall oral comfort following completion of restorative treatment. Inadequate moisture control, improper adhesive application, insufficient curing, and incorrect contour reconstruction were

identified as major contributing factors associated with restoration failure and development of secondary complications.

4. Discussion

The findings confirm that successful management of Black Class 3 carious lesions depends on accurate cavity preparation, preservation of healthy dental structures, effective adhesive protocols, and proper restorative techniques. Contemporary minimally invasive dentistry emphasizes conservative removal of infected tissue while maintaining maximum structural integrity of enamel and dentin. The study demonstrates that adhesive composite restorations provide substantial advantages in aesthetic rehabilitation, structural reinforcement, and functional restoration of anterior teeth affected by proximal carious destruction. Modern composite materials exhibit improved mechanical properties, wear resistance, optical characteristics, and adhesive compatibility contributing to long-term clinical success. Effective isolation remains critically important because contamination with saliva or gingival fluids significantly compromises adhesive bond strength and restoration durability. Incremental composite placement and adequate polymerization reduce shrinkage stress and improve marginal adaptation, thereby decreasing risk of microleakage and secondary caries formation. Anatomical reconstruction of proximal contours and contact points additionally contributes to periodontal health and prevention of food impaction. Despite significant technological progress, several factors continue to influence restorative longevity including oral hygiene status, occlusal loading, dietary habits, parafunctional activity, and operator technique. Future development of restorative dentistry increasingly focuses on bioactive materials, nanocomposite technology, antibacterial adhesives, and regenerative approaches aimed at improving biological compatibility and long-term preservation of dental tissues. Comprehensive understanding of cariology, adhesive chemistry, dental anatomy, and operative techniques remains essential for optimization of restorative outcomes and maintenance of oral health. The findings confirm that successful management of Black Class 3 carious cavities depends on accurate operative preparation, preservation of healthy dental tissues, effective adhesive protocols, and precise anatomical restoration of anterior teeth. Contemporary minimally invasive dentistry prioritizes conservative elimination of infected structures while maintaining maximal preservation of intact enamel and dentin to improve long-term biomechanical stability and pulpal vitality. The study demonstrates that modern composite resin systems provide substantial clinical advantages including superior aesthetics, chemical and micromechanical adhesion, improved wear resistance, and preservation of natural tooth morphology. Adhesive technologies have significantly transformed restorative dentistry by reducing need for extensive mechanical retention and allowing more conservative cavity preparation approaches. Proper moisture isolation remains critically important because contamination during adhesive procedures significantly decreases bond strength and increases probability of marginal leakage and secondary carious destruction. Incremental layering techniques and controlled polymerization contribute to reduction of internal stress formation and improvement of restoration adaptation and durability. Anatomical reconstruction of proximal contact points and surface contours additionally supports periodontal health by preventing food impaction and bacterial plaque accumulation. Despite major technological advancements, restorative longevity continues to depend on multiple factors including oral hygiene status, dietary habits, occlusal loading, parafunctional activity, salivary composition, and operator skill. Future development in restorative dentistry increasingly focuses on bioactive restorative materials, antibacterial adhesives, nanocomposite technology, regenerative biomaterials, and minimally invasive diagnostic systems aimed at improving biological compatibility and long-term preservation of dental tissues. Comprehensive integration of operative dentistry, biomaterials science, preventive dentistry, and aesthetic rehabilitation therefore remains essential for optimization of restorative outcomes and maintenance of oral health.

5. Conclusion

Preparation and filling of Black Class 3 carious cavities require precise operative techniques focused on elimination of infected tissues, preservation of healthy dental structures, and restoration of aesthetic and functional integrity of anterior teeth. Minimally invasive cavity preparation combined with modern adhesive composite restoration significantly improves marginal adaptation, anatomical reconstruction, aesthetic appearance, and long-term clinical durability. Effective isolation, proper

adhesive application, incremental filling techniques, and adequate polymerization are essential for prevention of postoperative complications and recurrent caries. Contemporary restorative dentistry continues to advance through development of improved biomaterials and adhesive technologies contributing to optimization of treatment outcomes and preservation of oral health. Preparation and filling of Black Class 3 carious cavities require highly precise operative techniques focused on elimination of infected tissues, preservation of healthy dental structures, restoration of anatomical morphology, and achievement of optimal aesthetic and functional outcomes. Minimally invasive cavity preparation combined with modern adhesive composite restoration significantly improves marginal adaptation, biomechanical stability, color integration, and long-term clinical durability of restorations. Effective moisture isolation, accurate adhesive application, incremental filling protocols, and proper polymerization techniques remain essential for prevention of postoperative complications and recurrent carious lesions. Continuous advancement of restorative materials, adhesive technologies, and minimally invasive operative methods contributes substantially to improvement of anterior dental rehabilitation and preservation of oral health and patient quality of life.

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