FROM G.V. BLACK TO MINIMAL INTERVENTION: MODERN PRINCIPLES OF CAVITY PREPARATION IN PRECLINICAL RESTORATIVE DENTISTRY

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Abstract. *The article reviews the evolution of cavity preparation principles taught in preclinical restorative dentistry, from the classical concepts of G.V. Black to the contemporary philosophy of minimal intervention. Black's classification of carious lesions, the sequential steps of cavity preparation and the principle of "extension for prevention" are compared with adhesive, tissue-preserving approaches based on modern caries classification systems and selective carious tissue removal. The implications of this shift for the organisation of preclinical training on phantom heads and simulators are discussed.*

Keywords: *preclinical restorative dentistry, cavity preparation, Black's classification, minimal intervention dentistry, adhesive restorations, selective caries removal, dental education.*

INTRODUCTION

Dental caries remains one of the most widespread non-communicable diseases, and its restorative treatment forms the core of the general dental practitioner's daily work. The preclinical course of restorative dentistry is the stage at which students first acquire the manual skills, theoretical knowledge and clinical reasoning required to prepare and restore teeth before treating real patients. The quality of this stage largely determines the quality of future clinical work.

For most of the twentieth century, preclinical teaching was built on the principles formulated by Greene Vardiman Black, whose textbook on operative dentistry standardised cavity design and terminology [1]. Since the introduction of the acid-etch technique by M. Buonocore in 1955 [2] and the development of resin composites and glass-ionomer cements, restorative dentistry has moved towards adhesive, tissue-preserving concepts known as minimal intervention dentistry [3, 4]. The aim of this article is to compare the classical and modern principles of cavity preparation and to outline how this shift should be reflected in preclinical training.

MATERIALS AND METHODS

A narrative review of the literature was carried out. Classical and contemporary textbooks of operative dentistry, consensus statements of international expert groups and peer-reviewed articles indexed in PubMed were analysed using the keywords “cavity preparation”, “minimal intervention dentistry”, “selective caries removal” and “preclinical dental education”. Comparative and descriptive analysis methods were applied.

RESULTS AND DISCUSSION

Classical principles. G.V. Black divided carious lesions into five classes according to their location: Class I — pits and fissures, mainly on the occlusal surfaces of premolars and molars; Class II — proximal surfaces of premolars and molars; Class III — proximal surfaces of incisors and canines without involvement of the incisal angle; Class IV — proximal surfaces of anterior teeth with involvement of the incisal angle; Class V — the gingival third of the facial or lingual surfaces. A sixth class, covering incisal edges and cusp tips, was added later [5]. Black also proposed a strict sequence of preparation: outline form, resistance form, retention form, convenience form, removal of remaining carious dentin, finishing of the enamel walls and cleansing of the cavity [1, 5].

These rules were designed for non-adhesive materials such as dental amalgam and gold, which are retained mechanically. Consequently, the cavity had to be extended into “self-cleansing” areas according to the principle of “extension for prevention”, and undercuts, dovetails and flat floors were prepared even in sound tissue. The approach was logical for its time, but it led to the removal of a considerable amount of healthy enamel and dentin and weakened the remaining tooth structure.

Modern principles. Adhesive bonding to enamel and dentin made mechanical retention largely unnecessary. In 1997 G.J. Mount and W.R. Hume proposed a classification of lesions by site and size, which links the extent of the preparation to the actual extent of the disease rather than to the surface involved [6]. The International Caries Detection and Assessment System (ICDAS) introduced visual staging of lesion severity and supported non-operative management of early lesions [7]. The FDI concept of minimal intervention dentistry emphasises early detection, remineralisation of non-cavitated lesions, minimal operative intervention and repair rather than replacement of defective restorations [3, 4]. Finally, the International Caries Consensus Collaboration recommended selective removal of carious tissue: in deep lesions soft dentin may be left over the pulp to avoid exposure, provided that the restoration seals the cavity [8]. The main differences between the two approaches are summarised in Table 1.

Table 1. Comparison of classical and minimally invasive principles of cavity preparation

Criterion	Classical approach (G.V. Black)	Minimal intervention approach
Extent of preparation	“Extension for prevention” into self-cleansing areas	Limited to the extent of the carious lesion
Retention	Mechanical: undercuts, dovetails, parallel walls	Adhesive bonding to enamel and dentin
Restorative materials	Dental amalgam, gold	Resin composites, glass-ionomer cements
Carious tissue removal	Complete removal to hard dentin	Selective removal; soft dentin may remain near the pulp
Sound tissue	Sacrificed to obtain the required cavity form	Maximally preserved
Lesion classification	Classes I–V by surface location	By site and size; ICDAS staging of severity

Implications for preclinical training. Black’s classification and preparation steps remain valuable in preclinical teaching: they provide a common terminology, train the student’s understanding of tooth anatomy and develop fine motor control of rotary and hand instruments. However, the preclinical curriculum should present them as a historical and anatomical foundation rather than as a universal template. Exercises on phantom heads and artificial teeth should include conservative adhesive preparations, slot and tunnel preparations, the incremental placement of resin composite, the use of rubber dam isolation and matrix systems, and the repair of existing restorations [5]. Simulation technologies, including virtual reality and haptic simulators, allow students to practise repeatedly and receive objective feedback before entering the clinic [9]. Assessment criteria should reward preservation of sound tissue and correct indications as much as the geometric accuracy of the cavity.

CONCLUSION

Cavity preparation has evolved from mechanically retentive, extensive designs proposed by G.V. Black to adhesive, tissue-preserving minimal intervention. The classical principles retain their educational value as the basis of terminology and manual skills, but modern preclinical restorative dentistry should be built on lesion assessment by severity, selective carious tissue removal, adhesive techniques and simulation-based practice. Integrating these

principles into preclinical training will prepare future dentists to preserve the maximum amount of natural tooth structure and to provide durable, evidence-based restorations.

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