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Choosing Burs For Tooth Preparations: A Conscised Guideline

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Abstract:
Tooth preparation for fixed prosthodontics requires precise biomechanical execution to achieve optimal retention, resistance, marginal integrity, periodontal compatibility, and restoration longevity. Dental burs—varying in material, grit size, blade design, and geometry—significantly influence cutting efficiency, surface roughness, pulpal response, and marginal accuracy. Evidence from indexed prosthodontic and restorative dentistry journals supports sequential bur protocols incorporating diamond burs for gross reduction and multi-fluted carbide burs for finishing. Vital teeth require strict thermal control to prevent pulpal injury, while non-vital teeth demand structural preservation and precise margin configuration. This review synthesizes contemporary literature and proposes an evidence-based bur selection protocol for predictable prosthodontic outcomes.

Keywords: *Dental burs; Prosthodontics; Finish line; Diamond bur; Carbide bur; Pulpal response; Marginal adaptation.*

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I. Introduction

Successful fixed prosthodontic therapy depends on accurate tooth preparation that balances mechanical durability with biological preservation[1]. Rotary cutting instruments, particularly dental burs, directly affect the geometry and surface characteristics of prepared teeth[2].

Bur selection influences:

- Cutting rate
- Surface roughness
- Smear layer formation
- Heat generation
- Margin configuration
- Digital scan accuracy

Siegel and von Fraunhofer demonstrated that bur type significantly alters surface morphology and cutting efficiency during fixed prosthodontic preparation[3]. Ayad later confirmed that preparation surface characteristics influence marginal fit of extracoronal restorations[4].

Despite widespread clinical use, structured evidence-based guidelines remain limited. This review integrates indexed literature to guide bur selection in:

- Vital teeth
- Non-vital teeth
- Finish line preparation
- Margin finishing
- Digital workflows

II. History

Dental burs were manufactured at least 300 years before, and still widely used. These can be of steel followed by a coating of tungsten carbide or entirely made of tungsten carbide Maya with the other ancient cultures used to use the primitive "bow drills" with few different devices for preparing the round ornamental cavities in the teeth 1728 Pierre Fauchard, "Le Chirurgien Dentiste" first detailed description of dental practice represented the use of bow drill to prepare teeth with cutters.

1891, the S.S.White company gave revelation burs, which were the first machine-made steel burs.

In 1897, Willman and Schroeder of the University of Berlin, Germany, were credited for manufacturing the first diamond bur.

In 1942, diamond cutting instruments with 5000 rpm were introduced.

In 1947, Carbide Burs with 12,000 rpm replaced the steel burs.

III. Classification And Cutting Mechanisms

Diamond Burs
Diamond burs cut via abrasive action. Particle size determines aggressiveness[5].

Grit classification:
- Super coarse (150–200 µm)
- Coarse (125–150 µm)
- Medium (100–125 µm)
- Fine (30–60 µm)
- Superfine (<30 µm)

Diamond burs exhibit high cutting efficiency in enamel[6] and are recommended for bulk reduction[7]. However, they produce greater surface roughness compared to carbide burs[3].
Worn diamond burs increase friction and heat generation[8].

Tungsten Carbide Burs
Carbide burs cut by shearing action via fluted blades.

Flute configurations:
- 6–8 flutes → Cutting
- 12–20 flutes → Finishing
- 30 flutes → Ultra-finishing

Carbide finishing burs produce smoother surfaces and improved marginal adaptation[4,9].

IV. Biological Considerations

Pulpal Response in Vital Teeth
Zach and Cohen demonstrated that a 5.5°C intrapulpal temperature rise may cause irreversible pulp damage[10].
Diamond burs generate greater frictional heat than carbide burs under identical conditions[11]. Adequate coolant significantly reduces temperature rise[12].

Therefore, preparation of vital teeth requires:
- Copious air-water spray
- Intermittent cutting stroke.
- Sharp, unworn burs
- Progressive grit reduction

Excessive vibration and pressure may cause odontoblastic damage and postoperative sensitivity[13].

Non-Vital Teeth
Although pulpal preservation is not a concern, structural durability is critical. Endodontically treated teeth exhibit altered biomechanical behavior[14].
Margin precision remains essential to prevent microleakage and restoration failure[4,15].

V. Bur Selection During Preparation Phases

Gross Occlusal Reduction
Medium-grit diamond burs provide efficient enamel removal[6]. Coarse burs may produce excessive irregularity without clinical advantage[11].
Depth orientation grooves improve reduction accuracy and reduce over-preparation[16].

Axial Wall Preparation
Controlled taper (6–12 degrees) is essential for retention[1]. Bur geometry influences convergence consistency[16].
Sequential grit reduction (medium → fine) improves surface smoothness[9].

Finish Line Preparation
Finish line design affects stress distribution and marginal integrity[17].
Chamfer → Round-end tapered diamond
Shoulder → Flat-end cylindrical diamond
Radial shoulder → Round-end cylindrical diamond
Margin width should correspond to restoration material requirements[17,18].

VI. Margin Finishing And Surface Roughness

Surface roughness influences marginal adaptation[4].

Ayad demonstrated significantly improved marginal fit when finishing burs were used compared with cutting burs alone[4].

Carbide finishing burs (12–20 flutes) significantly reduce surface irregularities[3,9].

Ultrasonic preparation systems may produce smoother finish lines compared to rotary instruments[19].

VII. Digital Dentistry Considerations

Surface roughness affects digital scanning accuracy[20].

Smooth finish lines improve CAD/CAM margin detection[21].

Sequential diamond-carbide protocols enhance digital impression precision[20].

VIII. Thermal And Mechanical Considerations

Diamond burs produce greater frictional heat than carbide burs[11].

Coolant flow reduces pulpal temperature rise[12].

Worn burs increase pressure and heat generation[8].

Excessive axial force decreases cutting efficiency and increases thermal injury[13].

IX. Evidence-Based Clinical Protocol

Step 1 – Occlusal Reduction: Medium Diamond
Step 2 – Depth Grooves: Depth-Cut Diamond
Step 3 – Axial Reduction: Medium: Fine Diamond
Step 4 – Finish Line Formation: Shape-Specific Diamond
Step 5 – Margin Refinement: 12-Flute Carbide
Step 6 – Final Smoothing: 20–30-Flute Carbide

X. Discussion

Evidence supports combined diamond-carbide sequencing[3,4].

Diamond burs are indispensable for enamel removal[6]. Carbide burs enhance surface refinement and marginal precision[3,9].

In vital teeth, thermal control is critical[10,12].

Margin quality directly influences restoration adaptation and longevity[4,15].

Future research should evaluate long-term survival outcomes associated with bur sequencing protocols.

XI. Conclusion

Proper bur selection significantly influences prosthodontic outcomes.

- Medium-grit diamonds for bulk reduction
- Fine diamonds for refinement
- Multi-fluted carbide burs for margin finishing
- Strict thermal control in vital teeth
- Sequential grit reduction improves surface quality

An evidence-based bur protocol enhances restoration fit, biological preservation, and clinical longevity.

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