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Microscopic evaluation of diamond burs: Surface changes and cutting efficiency after repeated use

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Abstract

Background: The efficiency of diamond burs is critical for crown preparation in fixed prosthodontics. Progressive wear of burs compromises cutting ability and affects the quality of prepared surfaces.

Objective: To microscopically evaluate the surface changes in diamond burs after one and three crown preparations, and to correlate these changes with their expected clinical performance.

Methods: Fresh diamond burs and burs used for one and three crown preparations were examined under a digital microscope. Microscopic surface features were documented and compared. Observations focused on crystal sharpness, surface clogging, and debris retention.

Results: Fresh burs demonstrated sharp, evenly distributed crystals. After one use, partial wear and early clogging were evident. After three uses, severe particle loss, flattened surfaces, and significant clogging were observed. These changes correlate with reduced cutting efficiency, greater heat generation, and rougher tooth surfaces.

Conclusion: Diamond burs undergo rapid microscopic deterioration after repeated use. Replacement after two to three crown preparations is recommended to maintain cutting efficiency and ensure optimal surface finish.

Keywords: Diamond bur, crown preparation, microscopy, surface wear, prosthodontics

Introduction

Rotary cutting instruments, particularly diamond burs, are indispensable in prosthodontics. Their effectiveness depends on the sharpness and distribution of abrasive particles, which directly affect preparation efficiency, margin precision, and patient comfort [1-3]. Repeated use leads to particle loss, clogging, and decreased cutting efficiency. This results in rougher tooth surfaces, prolonged preparation time, and increased frictional heat [4, 5].

Although previous studies have described diamond bur wear under scanning electron microscopy (SEM), there is limited clinical documentation of progressive microscopic changes with successive crown preparations. This study aims to illustrate surface changes in diamond burs after one and three uses and discuss their implications for crown preparation.

Materials and Methods

- **Samples:** One new diamond bur and burs used for one and three full crown preparations.
- **Procedure:** Crown preparations were performed on extracted human teeth using high-speed handpiece with water coolant.
- **Microscopic Analysis:** Burs were examined under a digital microscope at magnification $\times 100$ – $\times 200$.
- **Parameters Evaluated:**
 - Integrity and sharpness of diamond crystals
 - Presence of debris or clogging
 - Flattening or loss of abrasive particles

Results

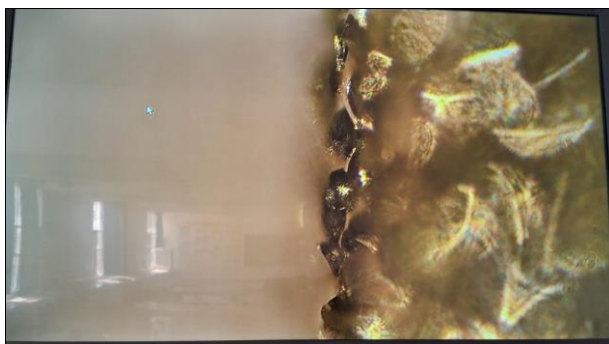


Fig 1: Fresh Diamond Bur

Observation: Sharp, angular, and evenly distributed crystals. Intercrystalline spaces open, ensuring efficient cutting and debris clearance.

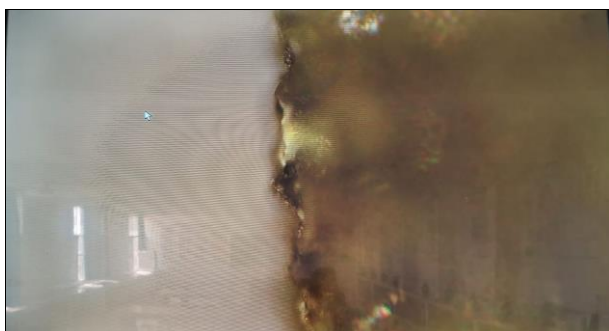


Fig 2: Diamond Bur After One Crown Preparation

Observation: Early particle wear and minor clogging. Some diamond crystals flattened or dislodged, but overall cutting ability retained

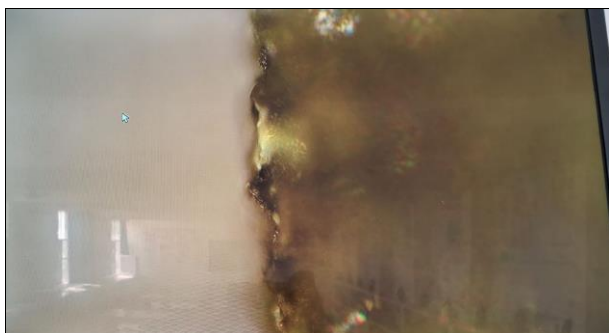


Fig 3: Diamond Bur After Three Crown Preparations

Observation: Severe abrasive loss, flattened cutting surface, and significant debris accumulation. Cutting efficiency markedly reduced; risk of frictional heat and irregular tooth surface increases.

Discussion

The progressive wear observed in this study aligns with earlier findings that diamond burs lose efficiency after limited use [2, 4, 6]. Fresh burs provide sharp and efficient cutting, while repeated use leads to loss of crystals, clogging, and heat generation. Clinically, dull burs may compromise margin definition, increase preparation time, and create rougher tooth surfaces [5, 7].

This supports the recommendation that diamond burs should be replaced after two to three heavy crown preparations to

maintain optimal performance.

Conclusion

Microscopic evaluation demonstrates that diamond burs deteriorate rapidly with repeated use. While fresh burs ensure smooth and efficient cutting, burs used three times show significant wear and clogging. To maintain precision and reduce biological risks, frequent replacement of burs is advised.

Conflict of Interest

Not available

Financial Support

Not available

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