



# Surface Characteristics of Tooth and Effectiveness of Diamond Points: A Systematic Review

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

Cutting efficiency of dental burs is sparse and inconsistent. Difficulty maintaining constant handpiece speed torque and controlled water spray action lack sufficient test materials mimic dental hard tissue. Diamond burs provided by manufacturers to dentists is coarse grit diamond burs with higher cutting rates. Medium grit burs favoured cutting instruments. Coarse grit diamond burs induce cracks in enamel while cutting. Diamond burs have one or more layers of diamond chips attached to the shank that get inserted into the hand piece. The shank is fabricated of high strength metal usually stainless steel, the working end or the cutting end of the shank is machined to specific shape or blank where diamond chips are attached. Therefore, the aim of this review is to determine the surface characteristics of the tooth and effectiveness of diamond points when prepared with different company products with subsequent usage. The study setting of this research is scoping review. The

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approval from the research committee was not required since it is a review. The minimum no. of articles are 18. In our research we reviewed a total of 50 articles. The sampling and data collection done by search engines such as PUBMED, Google scholar, bioRxiv, medRx, chemRxiv, CON, Mesh and from various journals of prosthodontics. The period of duration considered was upto2018. Diamond burs are the usual rotary instruments used for many restorative procedures such as cavity preparation for direct and indirect restorations, enameloplasty, grinding and polishing of definitive restorations and removal of defective restoration. A proper tooth preparation is essential for aesthetics, acceptable prosthetic rehabilitation, fracture resistance and healthy soft tissues. Dental burs are most commonly used instruments during clinical and laboratory procedures. Medium grit burs favoured more of the cutting instrument. Coarse diamond grit burs induced cracks in enamel cutting. Dental cutting diamond burs are heavy handed and light touch. Damage to the enamel subsurface in tooth preparation can be caused by diamonds

*Keywords: Diamond burs; tooth; cutting; heat; surface; dentistry.*

## 1. INTRODUCTION

“The shaping of tooth structure and surface is an essential aspect of restorative dentistry. Initially, the process for shaping was entirely based on the use of hand instruments” [1,2]. “Most dental restorations are extracoronal or intracoronal restorations or a combination of both. In order to maximize aesthetics, improve fracture resistance, optimize laboratory artistry and maintain soft tissue health meticulous tooth preparation is required. The potential damaging effect of temperature increases on pulpal surface during dental treatment. Preparation of cavities is regarded as a source of temperature increases and requires special attention” [3,4]. “The term bur is applied to all rotary cutting instruments that consist of bladed cutting heads which remove the tooth structure either by cutting or abrading. Earlier, the burs used were handmade and were made of steel. Carbide burs were launched in 1947 and replaced the steel burs for tooth preparation. The steel burs perform well in cutting human dentine at low speeds but dull rapidly at higher speeds or when cutting enamel. Once it becomes dull, the reduced cutting effectiveness will create increased heat and vibration. Restorative dentistry consists of a wide range of cutting instruments namely from steel burs to carbide burs to diamond abrasives. Bur selection is based on several factors like shape, clinical procedure being done, substrate being cut, their methods for sterilization and disposal” [5]. “The selection is complicated by the availability of the burs that drill in different sizes, coarseness and it gets more complicated by the fact that cutting efficiency of the burs tends to decrease as bur wears out and accumulation of debris on burs” [3]. “Diamond burs have one or more layers of diamond chips attached to the shank that get inserted into the hand piece. The

shank is fabricated of high strength metal usually stainless steel, the working end or the cutting end of the shank is machined to specific shape or blank where diamond chips are attached. The dimensions and shapes of blanks determine the size and shape of the bur” [6,7]. “They are widely used in dentistry across the world for its aspects like gross tooth reduction, margin refining, enameloplasty and finishing restorations” [8]. “Coarse grit diamond burs are used for gross tooth reduction with the tooth surface characteristics” [9,10]. “Fluoride strengthens the surface of the teeth” [11]. “Gingival margins exposure during tooth preparation before impression making is one of the most technique- sensitive procedures for the dentist to perform” [12].

## 2. MATERIALS AND METHODS

The study setting of this research is scoping review [13]. The approval from the research committee was not required since it is a review. The minimum no. of articles are 18. In our research we reviewed a total of 50 articles. The sampling and data collection done by search engines such as PUBMED, Google scholar, bioRxiv, medRx, chemRxiv, CON, Mesh and from various journals of prosthodontics. The period of duration considered was upto2018.

After collection of all articles, more specific articles were collected by using keywords such as tooth preparation, cutting, efficiency, diamond pints, surface, tooth, dentistry. There was a clear 5 step process in selection of these articles.

- 1) Identification of clear objectives
- 2) Identification of relevant articles

- 3) Selection
- 4) Data extraction and charting
- 5) Analysis and report

### 3. RESULTS AND DISCUSSION

#### 3.1 Cutting Efficiency

“A proper tooth preparation is essential for aesthetics, acceptable prosthetic rehabilitation, fracture resistance and healthy soft tissues” [14]. “Dental burs are most commonly used instruments during clinical and laboratory procedures. They are manufactured in different shapes and sizes with various utilization” [15]. “Secondary infection can be removed by the use of aloe vera” [16,17]. “Diamond burs have better cutting efficiency than other burs like carbide or stainless steel” [18]. “Alteration of cutting efficiency of diamond burs depends on hardness of surface particles, sterilization or disinfection procedures, storage conditions, corrosion and multiple use of the bur” [19]. “The cutting efficiency of burs evidently decreases after multiple usage as the number of cuts increases regardless of the type of bur used” [20]. “The reduction is highest after first use and these burs require excessive pressure application during tooth preparation which generates undesired heat and waste of time” [21,22]. In reference to [23], “the study proves the cutting efficiency of diamond burs and that diamond burs should be after every 5 preparations and the author also suggests that diamond burs used in tryin stages of metal and zirconia should not be used for tooth preparation”. “Cutting efficiency of dental burs is sparse and inconsistent” [24]. “The common problem faced by dentists during tooth preparation is difficulty in maintaining constant handpiece speed torque to controlled water spray action. Lack of sufficient test materials mimic the dental hard tissue” [25]. “Excessive pressure induced by diamond bur for cutting the surface causes bone damage” [26]. Steel burs are now commonly used for finishing procedures.

#### 3.2 Diamond Burs

“Diamond burs are the usual rotary instrument used for many restorative procedures such as cavity preparation for direct and indirect restorations, enameloplasty, grinding and polishing of definitive restorations and removal of defective restoration. It is necessary to use diamond rotary instruments with safe, fast and

efficient cutting, avoiding damage to dental surface, fatigue and structure and reducing heat generation” [27]. “One of the important characteristics of diamond bur is its cutting efficiency. The cutting efficiency of diamond bur is affected by grit size, coolant flow, load applied by operator design, tooth structure removal, repeated use and sterilization” [28]. “Diamond burs have one or more layers of diamond chips attached to the shank. The shank is fabricated from high strength metal. The cutting end of the shank is machined to specific shape or blank and diamond chips are attached. The dimensions and shape of blank determines the ultimate size and shape of bur. The diamond particles used for making or manufacturing diamond burs vary among manufacturers and the important parameters consist of natural or synthetic diamonds, chip size and shape as well as the individual particle faceting. Natural diamond burs are more irregular in shape when compared to synthetic. Diamond burs provided by manufacturers to dentists are coarse grit diamond burs which are higher in cutting rate” [29]. “Greater heating affects the cutting efficiency of coarse grit diamond burs” [30]. When compared, coarse grit diamond burs are generally preferred by practitioners than medium grit and fine grit diamond burs in reference to Prithviraj et al. [31] where the author has compared the cutting rates of medium coarse and super coarse grit diamond burs. The width of the teeth affects the cutting efficiency of diamond bur [2]. “For hygiene and sanitary safety purposes, all devices must be cleaned, disinfected and sterilized before each usage to prevent any contamination” [32]. The companies that supply effective and popular diamond burs are Dentsply Sirona, Kavo Kerr, Midwest Dental, Brasseler USA, 3M ESPE, Diatech Diamond Instruments, EVE Diamond Burs, Alpen Dental. Safco dental.

#### 3.3 Surface Characteristics

The surface characteristics in reference to diamond burs with reference [17]. Medium grit burs favoured more of the cutting instrument. Coarse diamond grit burs induced cracks in enamel cutting. Surface finishes done by fine grit diamond burs eliminate the cracks in reference to [5] because of differences in the dimensions of diamond particles used by individual manufacturers rugosities can vary quite markedly among burs of same nominal coarseness from different companies. Bur coarseness is determined by equations to mesh size of 120 to

140. A coarse grit bur is fabricated with chips sieved through mesh size of 80 to 100 and contains 150 to 160 diameter particles. The manufacturers way of quality control determines the range of chip dimensions within the mesh size used for each category of bur i.e, superfine, fine, medium or coarse. The dental burs classically have been described in terms of a discretional numerical code for head size and shape (for eg: 57 = 1mm diameter straight fissure bur; 34 = 0.8mm diameter inverted cone bur, 1mm diameter round bur). Newer classification systems developed by the International Standards Organization (ISO) tend to use separate identification for shape (usually shape name and size) usually a number giving the head diameter in tenths of a millimeter. The 5 aspects which the ISO classification for burs is based on the type of material, shank, shape, grit size, head diameter. Based on the type of material, it is classified into tungsten carbide bur and diamond bur. Based on shank, it is classified into, turbine dental burs, contra-angle dental burs and handpiece bur. Based on shape it is classified into, ball, conical, cylindrical, inverted cone, flame, pear, torpedo and wheel bur. The color coding is based on diamond grit that helps in easy identification during the treatment procedures.

1. Super coarse – black
2. Coarse – green
3. Medium - blue
4. Fine – red
5. Superfine – yellow
6. Ultra fine – white

### 3.4 Assessment of Burs

Dental cutting diamond burs are heavy handed and light touch. Damage to the enamel subsurface in tooth preparation can be caused by diamonds [5]. Assessing the cutting efficiency of dental diamond burs becomes necessary as using diamond burs with less cutting efficiency could lead to more pressure from the practitioners and causes heat generation that damages the pulp and pulpal tissues [33]. Clinical preference for diamond burs over tungsten carbide bur for a variety of dental procedures is based on greater resistance to abrasion, lower heat generation and longer life in reference to Siegel and Von Fraunhofer and [6]. In reference to Siegel and Von Fraunhofer [34] the authors examined or assessed the bur under optical stereo microscope and scanning electron microscopy.

## 5. CONCLUSION

Hence it could be concluded that within the limits of the review, diamond points of super coarse grit are more effective in gross tooth preparation of tooth when compared to medium grit diamond burs but dental professionals should be aware of the associated effects of the coarse grit on surface finish, heat generation and enamel damage.

## CONSENT AND ETHICAL APPROVAL

It is not applicable.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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