Effect of grit size of diamonds on the dentinal surface

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Abstract

Objective: 1. To find out the correlation between the roughness of diamonds and roughness created on dentin after tooth preparation
2. To measure the surface roughness of dentin after tooth preparation with different grit sizes of diamond rotary instruments.

Methodology: Extracted human molar teeth were used in the study. The enamel from buccal, lingual and occlusal surface of the teeth was sectioned. The remaining dentinal surface was prepared into a rectangular area. The specimens were divided into four groups based on the final grit size of the rotary cutting instruments used. The roughness of diamonds was measured before preparation using contact profilometer. For the coarse group (CG), specimens were prepared with a coarse grit diamond. For the medium group (MG), specimens were prepared with a coarse grit instrument followed by a medium-grit diamond. For the fine group (FG), specimens were prepared in the sequence from coarse, medium to fine grit size instruments. For the extra fine group (EFG), the specimens were prepared in the sequence from coarse, medium, fine to extra fine grit size instruments. The surface roughness (Ra) of the prepared specimens was then evaluated with a profilometer. Pearson correlation test was done to find out the correlation between the roughness of diamonds and roughness created on dentin.

Result: There is positive correlation (r=0.93) between the roughness of diamonds and roughness created on the dentin. Coarse diamonds which had a surface roughness of 10.6 μm produced surface roughness of 3.83 μm on the dentine. Similarly 8.3 μm medium grit diamonds produced 2.61 μm, 6.1 μm fine diamonds produced 1.64 μm and 2.5 extra fine diamonds produced 0.68 μm surface roughness on dentine.

Conclusion: There is a positive correlation between the surface roughness of diamond points and that of the dentin surface it creates. This correlation brings in predictability of the surface roughness of prepared tooth.

Keywords: Roughness, diamonds, dentin

Introduction

Coarse diamonds leave a rough surface on the dentinal surface while preparing the teeth. Even though the particle size of diamonds incorporated in the burs is generally mentioned by the manufacturers, it is never correlated with the surface roughness of the burs. Similarly the surface roughness of the diamond bur and the roughness created on the dentinal surface are also not compared. Smoother dentin surface produces better internal adaptation and less microleakage[1]. Smooth

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Fig. 1: Extracted tooth

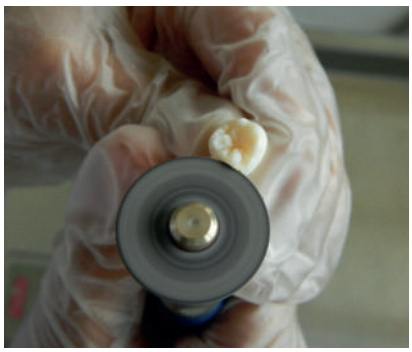

Fig. 2: Occlusal sectioning of enamel

Fig. 3: Buccal and lingual sectioning of enamel done and tooth embedded in an acrylic block

Fig 4. Tooth embedded in acrylic block

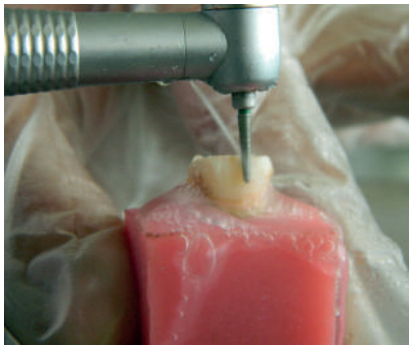

Fig. 5a and 5b: Preparation of rectangular area

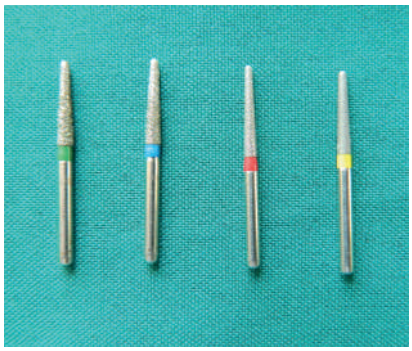

Fig. 6: Diamond burs

Fig. 7: Roughness of burs checked by contact profilometer

Fig. 8: Roughness of prepared specimens measured using contact profilometer

surface provides better retention with glass ionomer cements where as rough surfaces offer superior retention with zinc phosphate and resin cements[2]. Roughness of the prepared tooth has obvious clinical relevance. Hence, the present study was conducted to find out the correlation between the roughness of diamond burs and the roughness created by them on dentin and also to measure the surface roughness of dentin after tooth preparation with different grit sizes of diamond rotary instruments.

Materials and methods

Twelve extracted human molar teeth were selected and were stored in distilled water before use. (Fig 1) Enamel from the occlusal, buccal and lingual surfaces of the teeth was sectioned with carborundum disc to expose the dentin (Fig 2,3). The specimen was then embedded vertically in an acrylic block of dimension of 3x2x2cm up to the level of cementoenamel junction (Fig 4). Rectangular areas were prepared on both buccal and lingual surfaces at a dimension of 7x5mm having depth of 1mm (Fig 5a and 5b). The rotary instruments used for preparing dentine were round ended tapered burs (Dia-burs, Mani Inc.Tochigi, Japan) (Fig 6). The roughness of diamond burs was measured before preparation using contact profilometer (Fig 7). The specimens were divided into four groups based on the final grit size of the rotary cutting instruments used.

Table 1. *Surface roughness of diamond burs and prepared dentin (µm)*

Diamond burs	*Roughness of diamond points (µm)*	*Tooth Surface*	*Roughness of dentin Sample 1*	*Roughness of dentin Sample 2*	*Roughness of dentin Sample 3*	*Roughness of dentin Mean*
Coarse group	10.6	Buccal	4.65	3.45	3.31	3.83
Coarse group	10.6	Lingual	3.98	4.02	3.60	
Medium group	8.3	Buccal	2.44	2.56	1.90	2.61
Medium group	8.3	Lingual	2.86	3.21	2.73	
Fine group	6.1	Buccal	1.68	1.07	1.70	1.64
Fine group	6.1	Lingual	1.21	2.30	1.93	
Extra fine group	2.5	Buccal	0.51	0.89	0.88	0.68
Extra fine group	2.5	Lingual	0.53	0.70	0.61	

Description of grit size	*Type*	*Color code*	*Grit size (µm)*
Coarse (CG)	TR-13C	Green	125-150
Medium (MG)	TR-12	Blue	106-125
Fine (FG)	TR-25F	Red	53-63
Extra fine (EFG)	TR-25EF	Yellow	20-30

The duration of tooth preparation was standardised to 40 seconds. Group - CG, specimens were prepared with a coarse grit diamond for 40 seconds. Group - MG, specimens were prepared with a coarse grit diamond for 30 seconds, followed by a medium-grit diamond for 10 seconds. Group - FG, specimens were prepared in the sequence - coarse for 25 seconds, medium for 10 seconds and fine grit for 5 seconds. Group – EFG, specimens were prepared in a sequence viz. coarse - 20 seconds, medium -10 seconds, fine - 5 seconds and extra fine - 5 seconds. A new instrument was used to prepare each specimen and a continuous water jet was directed at the rotary instrument. The preparation was done in one direction, with the long axis of the rotary cutting instrument parallel to the surface of the specimens. After the tooth preparation, specimens were stored again in distilled water. Surface roughness (Ra) of the prepared specimens was then evaluated quantitatively with a contact profilometer (Taylor-Hobson, Paoli, Pennsylvania) (Fig 8). Pearson correlation test was done to find out the correlation between the roughness of diamonds and roughness created on dentin.

Results:

Coarse diamonds which had a surface roughness of 10.6 µm produced surface roughness of 3.83 µm on the dentine. Similarly 8.3 µm medium grit diamonds produced 2.61 µm, 6.1 µm fine diamonds produced 1.64 µm and 2.5 extra fine diamonds produced 0.68 µm surface roughness on dentine. Pearson correlation test showed that there is a positive correlation ($r = 0.93$) between the roughness of diamonds and roughness created on the dentin. (Table-1)

Discussion:

From the result it was noticed that the roughness present on the surface of diamond points was not copied on the surface of dentin and the roughness created on dentin was around one third of the roughness of diamonds. There is positive correlation between the roughness of diamonds and roughness created on the dentin. As the roughness of diamond bur increases the roughness of dentin also increases. In order to have an idea about the roughness of dentin, it is necessary for us to know the roughness of the diamond surface. So manufacturer should mention the roughness of diamond points rather than particle size. Similar studies specifically related to surface roughness of diamond points is not documented in the literature.

Conclusion:

It was concluded that there is a positive correlation between the surface roughness of diamond points and that of the dentin surface it creates. This correlation brings in predictability of the surface roughness of prepared tooth.

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