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THE EFFECT OF MULTIPLE USAGE AND SURFACE COARSENESS OF DIAMOND BURS ON MARGINAL MICROLEAKAGE OF RESIN COMPOSITE RESTORATIONS

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ABSTRACT:

Aim: to compare the effect of multiple usage and surface coarseness of diamond burs on marginal microleakage of cervical resin composite restorations.

Materials and methods: ninety sound extracted premolars were chosen. The sample was randomly divided into three groups: N1=N2=N3=30. Group(1): was divided into two subgroups (A1=20,B1=10) . Group A1 was prepared by using super coarse diamond burs, but for group B1, after preparation the internal walls of cavities were finished by super soft diamond bur.

group(2):was also divided into two subgroups(A2=20,B2=10). Teeth of group A2 were prepared by coarse diamond burs but, after preparation the teeth of group B2, the internal walls of cavities were finished by super soft diamond bur whereas group(3) was divided into two sub groups(A3=20,B3=10). Teeth of group A3 were prepared by medium coarse diamond burs whereas, after preparation the of group B3, the internal walls of cavities were finished by super soft diamond bur.

All cavities were restored by resin composite, then The teeth were thermocycled and immersed in5% solution of methylene blue dye for 12 hours.Then the teeth were sectioned vertically, Dye penetration was evaluated using a 10X stereomicroscope at the occlusal and gingival margins. Data were collected and statistical analysis was conducted.

Results: The results showed that the multiple use of super coarse diamond burs caused no significantly statistically affect on occlusal and gingival microleakage ($P>0.05$). However, the multiple use of coarse and medium diamond burs caused significantly statistically affect on gingival marginal microleakage ($P<0.05$).

Conclusion: under the conditions of this study, it can be concluded that the multiple use of super coarse diamond burs did not affect on occlusal and gingival microleakage. Whereas the multiple use of coarse and medium diamond burs affected on gingival marginal microleakage.

Key words: cervical cavities, diamond burs, multiple use, marginal microleakage.

INTRODUCTION:

The tooth preparation of dental tissues is one of the most important stages of restorative treatment, which aims to replace the defective dental tissues with material that helps to maintain proper form, function and esthetics. Whereas the preparation of dental tissues requires use of mechanical tools that are capable of cutting tooth tissues, these tools include including rotary burs that vary in their patterns and characteristics as well as the nature of the materials from which these tools are made [1]. The most common types of rotary burs are steel, tungsten carbide and diamond. Diamond rotary instruments have great clinical impact because of their long service life and great efficiency in cutting

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both the enamel and dentin[2]. In additional diamond burs vary in shape and surface roughness depending on the size of the diamond particles which are positioned of the head of the burs[1]. On the other hand the coarseness of dental bur, which used in the cutting of tooth tissues, affects on the properties of tissue surface, in addition to its impact on the quality and quantity of the smear layer resulting from the preparation [3,4].

It is also common among dentists repeated use of dental diamond burs which may affect the effectiveness of these burs and thus impact on the surface of the prepared cavity [2].

The integrity and durability of the marginal seal are important factors in the longevity of adhesive dental restorative materials, particularly for composite resins, where there is two-ways interaction in which the potentiality for leakage is influenced not only by the surface structure of the prepared tissues, but also by the composition and physical properties of the restorative materials that applied to the prepared tissues. [4]

The clinical success of dental restorations depends on the knowledge of chemical bonding materials and clinical application of these materials ,in addition to knowledge of morphological changes of these restorations [5].

The microleakage is one of the most important problems that follow composite resin restorations application , which in turn could result from the gaps between the material and the surface of prepared tissues. However these gaps could be caused by polymerization shrinkage of the composite resin restorations with or without poor adhesion of dentin bonding agents between the dentin and composite material [6].

Microleakage could lead to many consequences, such as discoloration of the restoration, marginal break down, recurrent caries, pulpal inflammation and post operative sensitivity which may affect the longevity of restoration and ultimately the vitality of the dental pulp[7,8].

one study of von Fraunhofer found that reuse of disposable diamond burs can affect microleakage . However, he found that the use of a disposable bur to prepare more than three preparations increased microleakage and the microleakage within teeth, that were reprepared and restored, was more than ones that have been prepared for first time[9].

M.R. Malekipour found in his study that, the cutting efficiency of diamond burs have a great increasing impact on microleakage of composite resin restorations. Consequently, the long term use of burs could produce an increasing microleakage of class v composite resin restorations [10].

Another study showed that the majority of surveyed dentists were using diamond burs until the end of their effectiveness [11].

The aim of the this study was to compare the effect of multiple usage and surface coarseness of diamond burs on marginal microleakage of cervical resin composite restorations.

MATERIALS AND METHODS:

Ninety sound extracted human premolars were chosen. The sample was stored in 9% NACL solution after extraction, and cleaned calculus, soft tissue and debris with hand instrument.

The sample was randomly divided into three groups: N1=N2=N3=30.

First group: teeth were divided into two sub- groups (A1,B1).

(A1 sub- group n=20) teeth were prepared with new super coarse diamond burs (Komet dental.Germany)

(B1 sub-group n=10) teeth were prepared with new super coarse diamond burs (Komet dental.Germany), but after preparation, the walls of cavities were finished by using super soft diamond burr (Komet dental.Germany)

second group: teeth were divided in two sub- groups (A2,B2):

(A2 sub- group n=20) teeth were prepared with new coarse diamond burs (Komet dental.Germany)

(B2 sub- group n=10) teeth were cut with new coarse diamond burs (Komet dental.Germany) ,but after preparation, the internal walls of cavities were finished by using super soft diamond burr(Komet dental.Germany)

third group: teeth were divided in two sub groups (A3,B3):

(A3 group n=20) teeth were prepared with new medium coarse diamond burs (Komet dental.Germany).

(B3 sub-group n=10) teeth were prepared with new medium coarse diamond burs (Komet dental.Germany) ,but after preparation the internal walls of cavities were finished by using super soft diamond burs(Komet dental.Germany).

For all samples class V cavities were made using one of those different burs in an air/water cooled high speed headpiece (NSK,JAPAN). A new bur was used for every five preparations. The cavity preparations were standardized with a width of 2.5 mm and a height of 2.5 mm and a depth of 1.5 mm.

The occlusal wall of the cavity was limited in the enamel wall while the gingival wall of the cavity was extended beyond the CEJ onto the cementum. The occlusal and gingival cavosurface margins were not beveled. At the end of the cavity preparation, All prepared cavities were washed for 15 seconds with an air/water spray and the excessive water was removed with a gentle air spray leaving the preparation slightly moist. the cavity was etched by 37% phosphoric acid (N-Etch,ivoclar-vivadent) for 30 seconds total etch time of the enamel, and 15 seconds of the

dentin and cementum .after that rinse by water for 10 seconds, then a light stream of air leaving the surface slightly moist. Bonding agent was used for all groups(ivoclar-vivadent**,**Tetric N Bond) by applying bond into the prepared surface and rubbing the bonding resin into the dentin, enamel and cementum with the applicator brush tip. Bond was thinned with light two seconds air spray. This was followed by 20 second light polymerization using an LED light curing unit with 600 mw/cm ² light intensity. In all cavities , the composite restorative material (Tetric N ceram, ivoclar-vivadent) was placed and condensed incrementally, whereas the thickness of each layer was not more than 2 mm, until the cavity was completely filled. Each increment of restorative material attempted to involve only two walls of the preparation to reduce shrinkage and direct stress strain away from the internal walls. Each increment was light polymerized for 30 seconds prior to placement of the next increment.

After 24 hours all the restorations were finished, if there is a need to that then, all Samples were then subjected to 500 thermocycles at 5°c,55°c with a 20 second dwell time. After cycling, the apices of all root surfaces were sealed with adhesive wax and two coats of finger nail on all extra surface of teeth expect 1 mm around the tooth - composite interface. then, the teeth were immersed in a 5% solution of methylene blue dye for 12 hours.

Then , the teeth were washed under running water and left them to dry for dye fixation. The samples were then sectioned once vertically approximately midway through the facial surface using a diamond coated cutting disk. Dye penetration was evaluated using a (10X) stereomicroscope at the occlusal and gingival margins. Microleakage scores were based on the degree of dye penetration according to the criteria described in Table 1[12].

Statistical analysis:

Statistical analysis was performed after the collection of data using SPSS version 16 software, which performed statistical analyzes with the adoption of a significant level of significance (α = 0.05).

RESULTS:

Mean rank of dye penetration for the groups at occlusal and gingival margins, and results of the Kruskal- Wallis are presented in table2,3. Mean rank, and results of the Mann-Whitney are presented in table4,5,6. The results showed that the multiuse of super coarse diamond burs for five usages did not effect on the the microleakage of resin class v composite restorations at the gingival neither – nor occlusal walls($P > 0.05$). On the other hand, the multiuse of coarse and medium coarse diamond burs for five usages affected on the the microleakage of resin class v composite restorations at the gingival walls only.

The Mann-Whitney test revealed that microleakage was similar for the first, second, and the third use of the coarse diamond burs at the gingival walls, but the microleakage for the fourth use was more than for the first one ($P < 0.05$). also The Mann-Whitney test revealed that microLeakage was similar for the first,second,third, and fourth use of the medium coarse diamond burs at the gingival walls, but was more than for the fifth use ($P < 0.05$). In addition, The Mann-Whitney test revealed that the finishing of internal walls of cavities after preparation with super coarse diamond burs caused microleakage more than one occurred by preparation without finishing at the occlusal walls.

In contrast the finishing did not effect on microleakage after preparation with coarse and medium coarse burs at both the occlusal and gingival walls. by comparing the microleakage resulting from multi usage of different types of burs: super coarse, coarse, and medium coarse, with or without internal walls finishing, the results showed that no significant differences were seen among the three groups.

DISCUSSION:

It is a fact that cutting efficiency of burs tends to decrease as burs wear out and as debris accumulate on the burs. Studies have shown that cutting efficiency depends on both the diamond bur grit size and duration of the cutting procedures[2]. Most of the Physicians showed a positive affinity towards the diamond burs for tooth reduction . The aim of the present study was to compare the three coarseness :super coarse, coarse, and medium coarse, of Diamond burs, which used in the preparation of dental cavities , as well as the effect of the sequential use of these burs on the gingival and occlusal microleakage of cervical resin composite restorations.

Dental diamond burs are characterized by having a high resistance to abrasion and result low temperature from usage as well as they can be used for a long time compared with other types of dental burs, so it a favorite choice among dentists [13-18]. Diamond burs have become the primary tools used by dentists in various types of preparation of dental tissues as preparation for the fixed prosthodontics and restorative procedures. In this study diamond burs were selected because of their highly effective in cutting of dental tissues as they are the most widely method among dentists that used for the preparation of dental cavities.

The gingival wall of class v cavities is considered as so difficult wall to be restorated and sealed. In addition, there is the cementum , which decreases the adhesion of composite on this wall.

Microleakage is considered as challenge facing the dental restorations, which results from lack of proper application between dental restorative materials and the walls of the cavities [19,20]. Many recently techniques and different ways have been developed to study

microleakage, but this study was based on technique using methylene blue solution because In it is simple and proper method [21].

The current study found that the sequential use of super coarse diamond burs five times in the preparation of cervical cavities did not lead to a statistically significant change on both the occlusal and gingival microleakage. While the sequential use of coarse and medium coarse diamond burs led to a statistically significant change on the gingival microleakage . For coarse burs, the study did not show any differences between the first and third use of coarse burs while there was a statistically significant difference between first and fourth use in terms of gingival microleakage. The results showed, that the fourth use of coarse burs caused more gingival leakage compared with the first use, but for the sequential use of medium coarse burs, there was no statistically significant difference between the first and the fourth use, while there was a statistically significant difference between first and fifth usage according to gingival microleakage. In general, that could be due to the low cutting efficiency of coarse and medium coarse burs. However the studies confirmed that the repeated use of burs leads to lower cutting efficiency in addition to wear of these burs, consequently these could affect the structure of the prepared tissues (dentin, cementum), and the structure of prepared tissues affect the quality of marginal seal for composite resin restorations[2]. In addition, this microleakage may be due to the quality and quantity of smear layer resulting from the preparation, where the studies showed a difference in the quality and quantity of the smear layer depending on the roughness of diamond burs [4]. The result of the current study was agreement with von Fraunhofer study, which found that the sequential use of diamond burs cause an increase in microleakage after the third use of the burs [9].

Hense, the current study found no differences between the three coarseness: super coarse, coarse and medium coarse according to both the gingival and occlusal microleakage. This varies with M.R. Malekipour study, which found that gingival leakage is depending on the coarseness of used burs [10]. The reason for the difference may be due to that the latest study depended on both used and new diamond burs whereas the current study depended on new ones [10].

On the other hand, the current study found that the finishing of the internal walls of the cervical cavities led to a statistically significant change on the occlusal microleakage in cavities, which have been prepared by using super coarse diamond burs. While this finishing of the internal walls of the cervical cavities did not affect on the occlusal and gingival microleakage in cavities, which have been prepared by using coarse and medium coarse diamond burs. There are no previous

studies have touched on this subject. Also The current study did not find any differences among the three groups according to the finishing of the internal walls of cavities in terms of their effect on microleakage.

CONCLUSIONS:

Depending on the results of the current study, we find:

1. the sequential use of super coarse diamond burs in the preparation of dental cavities did not lead to an impact on both gingival and occlusal microleakage.
2. the sequential use of coarse and medium diamond bur s in the preparation of dental cavities led to an impact on gingival microleakage .
3. There are no differences between the coarseness of diamond burs: super coarse, coarse, and medium coarse in them impact on the gingival and occlusal microleakage.
4. The finishing of internal walls of cervical cavities which prepared by using super coarse diamond burs led to increase the occlusal microleakage without gingival, while the finishing of internal walls of cervical cavities which prepared by using coarse and medium coarse diamond burs did not affect both the occlusal and gingival microleakage.
5. There are no differences between following finishing of internal walls of cervical cavities which prepared by the three coarseness of diamond burs on its affect on microleakage.

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TABLES:

Table (1) dye penetration score

Microleakage Score	Degree of Dye Penetration
0	No dye penetration
1	Dye penetration less upto 1/3of the lengeth of the gingival or occlusal wall
2	Dye penetration less from 1/3 to 2/3 of the lengeth of the gingival or occlusal wall
3	Dye penetration greater than score 2 but not including the axial wall
4	Dye penetration with penetration spreading along the axial wall

Table (2) Mean rank, and results of the Kruskal- Wallis test of dye penetration for the groups at gingival walls.

Coarsenss of burs	Mean rank-gingival wall without finishing					K.W	p.value
	usage						
	first	second	third	fourth	fifth		
Super coarse	11.50	5.50	11.50	10	14	4.905	0.279
coarse	4.50	7.50	7.50	11.50	11.50	16.625	0.002
Medium coarse	5.50	5.50	11.00	12.50	18.00	13.722	0.008

Table (3) Mean rank, and results of the Kruskal- Wallis test of dye penetration for the groups at occlusal walls.

Coarsenss of burs	Mean rank-occlusal wall without finishing					K.W	p.value
	usage						
	first	second	third	fourth	fifth		
Super coarse	9.50	14.50	9.50	9.50	9.50	8.444	0.077
coarse	9.50	9.50	14.50	9.50	9.50	8.444	0.077
Medium coarse	8.50	8.50	13.50	8.50	13.50	7.125	0.129

Table(4) Mean rank, and results of the Mann-Whitney test

Coarsenss of burs	Mean rank				p.value	
	Occlusal wall		Gingival wall		occlusal	gingival
	With finishing	Without finishing	With finishing	Without finishing		
Super coarse	18.70	13.90	15.90	15.30	0.043	0.854
coarse	16.00	14.50	18.70	13.90	0.309	0.139
Medium coarse	15.50	15.50	17.10	14.70	1.000	0.469

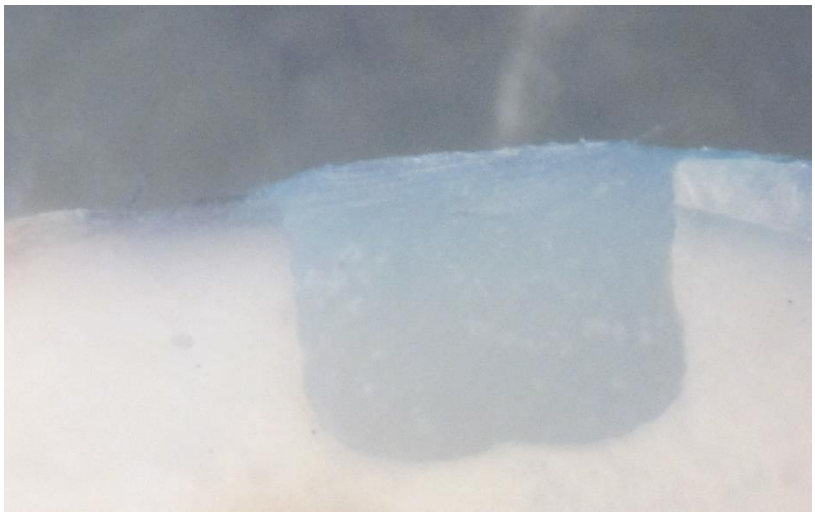
Table(5) Mean rank, and results of the Mann-Whitney test

Coarsenss of burs	Mean rank - Without finishing		p.value	
	Occlusal wall	Gingival wall	occlusal	gingival
Super coarse	29.50	31.00	0.567	0.795
coarse	29.50	28.50		
Medium coarse	32.50	32.50		

Table(6) Mean rank, and results of the Mann-Whitney test

Coarsenss of burs	Mean rank - With finishing		p.value	
	Occlusal wall	Gingival wall	occlusal	gingival
Super coarse	18.70	13.30	0.077	0.566
coarse	12.50	17.30		
Medium coarse	15.30	15.90		

FIGURES:



Figure(1) score(0) of dye penetration at both occlusal and gingival walls