The effectiveness of a new diamond and carbide fissure burs in cutting amalgam and composite materials

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ABSTRACT

Background: Frequently, new types of burs are developed. The purpose of this study was to evaluate the cutting rates of a new diamond and carbide fissure bures on amalgam and composite materials.
Materials and Methods: The cutting study was performed on composite and amalgam an specimens the specimens were divided into groups and subgroups according to the types of bur and material of the specimens: Group I subgroup 1, composite specimens (10 diamond fissure burs), Subgroup 2, amalgam specimens (10 diamond fissure burs), Group II subgroup 1, composite specimens (10 carbide fissure burs), Subgroup 2, amalgam specimens (10 carbide fissure burs). Ten cuts were performed with each bar and a total of 400 cutting rates or CRs (mm/sec) were recorded. The CRs were statistically analyzed using analysis of variance test, least significant difference test and student t-test.
Results: There was no significant difference (P< 0.5) between CRs of group I for the 10 cuts, while a significant difference (P < 0.5) began to appear between CRs of group II subgroup 1 after cut 7 and in subgroup 2 after cut 8
Conclusion: Both diamond and carbide fissure burs are effective in cutting amalgam and composite materials, but still carbide fissure bure dulls readily.

Keywords: Effectiveness, burs, amalgam, composite. **(J Bagh Coll Dentistry 2008; 20(2)26-29)**

INTERODUCTION

Diamond burs were introduced in the united states in 1942 and had great clinical impact because of their long life and great effectiveness in increased rotational speeds at a time when interest in increased rotational speed was been beginning. [1] Carbide burs were introduced in 1947, carbide burs perform well at all speeds and their superiority is greatest at high speed. [1-3]

Although the development of new bur sizes and shapes has greatly increased the number of different types in current use, the number actually required for clinical effectiveness has been reduced. [3,4]

There do not appear to be any evidence based data on the optimal selection for diamond or carbide burs.

Bur selection and use are complicated by the fact that cutting effectiveness tend to decrease as burs dulled, when they wear out (specially at higher speed) and as debris accumulated on the bur.[6,7] As a result, dentist may press harder on the tooth to maintain the cutting effectiveness that was possible before the bur performance degraded[5], and creates increased heat and vibration.[6] The purpose of this study was to evaluate the cutting rates of anew diamond and carbide fissure burs on amalgam and composite materials.

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MATERIALS AND METHODS

A controlled test regimen was performed using KaVo high speed hand piece mounted on a surveyor at a cutting force of 100g with a coolant flow rate of 25 milliliter per minute.[7-9]

A rectangular plastic molds (78X13X13mm) were used in fabricate amalgam (Amalcap plus, Ivoclar, Vivadent) and composite (Composan LCM, Promedica, Germany) specimens. (Figure 1) the manufacturer instruction was followed.

The amalgam was placed incrementally and well condensed; the surface was burnished with burnisher. The composite was placed and light cured in layers of 1-5 mm, the surface layer was covered with glass slides after placing of plastic strip, followed by light activation.

Cutting was performed either with diamond fissure bur (Dia-Burs, SF- 1) or carbide fissure bur (Depha Carb F6 314), (Figure 2), and cutting rates or CRs of diamond and carbide fissure burs in cutting composite or amalgam (mm/sec) were determined as the time in seconds it took the diamond or carbide fissure bur to transect the specimen with 3 mm depth of each bur.[3,7,8]

The specimens were divided into two groups according to the types of burs:
Group I, cutting performed with diamond fissure burs (20 burs).
Group II, cutting performed with carbide fissure burs (20 burs). Each group was further subdivided into two subgroups according to the material being used in construction of the specimen.
Subgroup 1. composite specimens (10 burs).
Subgroups 2. amalgam specimens (10 burs).

Ten cuts were performed with each bur began with cut 1 (13 mm) and ended up with cut 10 (130 mm). The CRs data was obtained, and total of 400 CRs measurements were recorded. The CRs were statistically analyzed by analysis of variance (ANOVA) test and least significant difference (LSD) test. The mean CRs for all ten cuts were statistically analyzed using student t-test.

Table 1:CRs (mm/sec) of composite and amalgam for diamond and carbide fissure bur.

Cut	Group I		Group II	
	Sub 1	Sub 2	Sub 1	Sub 2
1	1.342(0.17)±	1.044(0.21)±	2.038(0.09)±	1.913(0.51)±
2	1.022 (0.14)	0.897 (0.11)	0.973 (0.07)	0.939 (0.39)
3	0.878 (0.13)	0.872 (0.09)	0.872 (0.08)	0.857 (0.46)
4	0.788 (0.08)	0.696 (0.06)	0.755 (0.06)	0.798 (0.22)
5	0.772 (0.09)	0.642 (0.04)	0.692 (0.07)	0.515 (0.51)
6	0.758 (0.07)	0.619 (0.03)	0.542 (0.05)	0.35 (0.21)
7	0.728 (0.03)	0.568 (0.04)	0.471 (0.03)	0.269 (0.11)
8	0.723 (0.01)	0.422 (0.03)	0.35 (0.04)	0.255 (0.02)
9	0.567 (0.02)	0.414 (0.02)	0.35 (0.02)	0.196 (0.09)
10	0.566 (0.01)	0.411 (0.05)	0.24 (0.02)	0.181 (0.07)
Mean CRs for all ten cuts	0.813 ± 0.075	0.658 ± 0.067	0.729 ± 0.053	0.627 ± 0.29

RESULTS

The CRs (mm/sec) of composite sand amalgam for diamond and carbide fissure burs for the ten cuts are summarized in table 1 and figure 3 and 4.

It is clearly obvious that CRs decreased with prolonged duration of the cutting procedure, group II (carbide fissure burs) showed higher CRs than group I (diamond fissure burs) at cut 1, while showed lower CRs at cut 10.

Furthermore, group II (carbide fissure burs) subgroup 1 (composite specimen) cut 1 showed the highest mean CR (2.038 + 0.09 mm/sec), while group II (carbide fissure burs) subgroup 2 (amalgam specimen) cut 10 showed the lowest mean CR (0.181 ± 0.07 mm/sec)

Group I (diamond fissure burs).

The statistical analysis of the CRs data for group I using ANOVA test showed no significant difference (P > 0.5) between CRs for the ten cuts.

Group II (Carbide fissure burs).

The statistical analysis of the CRs data for group II using ANOVA test showed a statistical significant difference, further analysis using LSD test (LSD 0.5=1.605) showed a significant difference began to appear in group II subgroup 1 (composite specimen) after cut 7 and in subgroup 2 (amalgam specimens) after cut 6 in comparison with cut 1 (control)

Comparison between The mean CRs for all ten cuts.

The mean CRs for all 10 cuts of the 4 subgroup were statistically analyzed using student t-test, and there was no significant difference (P> 0.5) between the 4 subgroups.

Figure 1: Construction of the specimen

Figure 2: Diamond Fissure bur (above and carbide fissure bur (bellow).

DISCUSSION

There has been a research activity in dental cutting studies stemming from several developments in contemporary dentistry. one of these developments is the introduction of different types of burs.[5] Further, economic pressures require dentists to perform such cutting procedure as caries removal and cavity preparation as rapidly and efficiently as possible with out damaging the health of the vital tooth.[5]

Diamond burs are based on small, angular particles of a hard substance held in a matrix of softer material,[10] carbide burs have heads of cemented carbide in which microscopic carbide particles, usually of tungsten carbide, are held together in a matrix of cobalt or nickel. This difference in design causes definite differences in mechanism by which the two types of instrument cut and in the application for which they are best suited. (10,11)

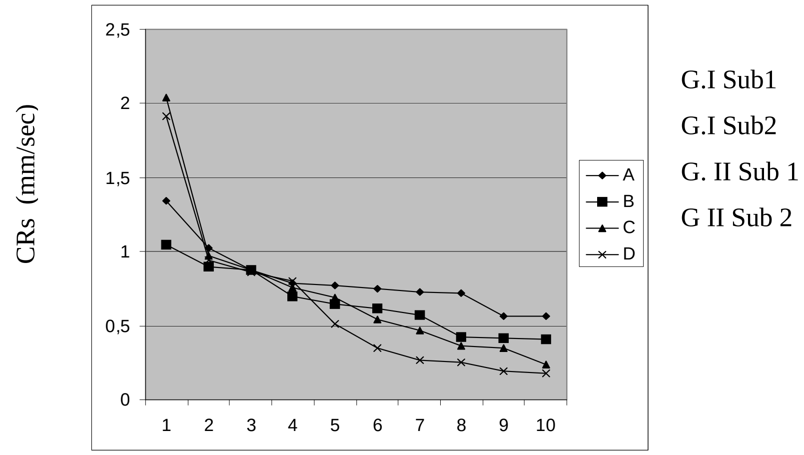

Figure 3 : Polygon chart showes the diamond and carbide CRs for 10 cuts

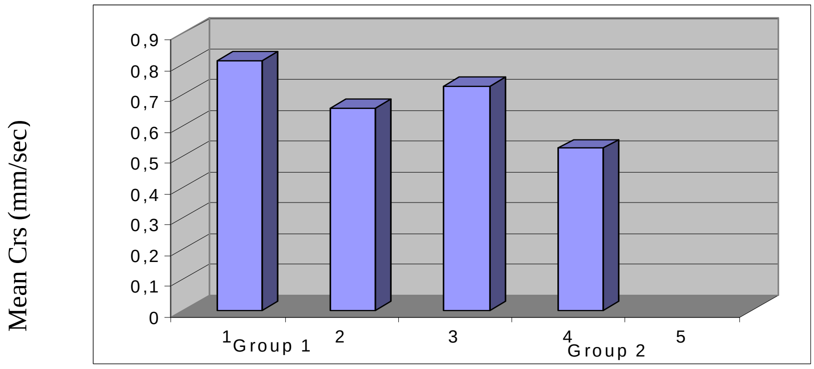

Figure 4: Bar chart shows the difference in mean CRs (for all ten cuts) of the 4 subgroups.

The results of the cutting study indicated that the CRs decreased with prolonged duration of cutting, these findings attributed to the fact that cutting effectiveness tend to decrease as bur wear out and as debries accumulated on the bur,[5,6] these findings in agreement with wasteland IN et al 1980[6] and Siegel Sc et al 2000.[5]

Group I (diamond fissure burs).

The results showed no significant difference between the means of diamond CRs for the ten cuts, these findings attributed to the following reasons:

1- Cutting mechanism with diamond fissure bur.

The cutting with diamond bur occurs at a large number of diamond points resulting in tensile fracture that produce a series of subsurface cracks, such a mechanism make the diamond burs efficient when used in cut brittle materials, and since composite and amalgam are brittle material [12], therefore with proper speed and pressure , diamond burs will last almost indefinitely.[3,13]

2- The hardness of diamond fissure bur.

In order for the bur to initiate the cutting, it must be sharp and has a higher hardness than the material being cut, the high hardness essential to concentrate the applied force on a small enough area to exceed the shear strength of the material being cut. Knoop hardness (KHN) values of dental composite 41-80 , dental amalgam 110 while diamond 7000, therefore diamond bur less subject to wear during cutting procedure.[3,12]

Group II (Carbide fissure burs)

The results showed a significant difference in carbide CRs with prolonged duration of cutting, these results attributed to the following reasons:

1- The mechanism of cutting with carbide burs.

The cutting with carbides occur a long a continuous edge of carbide, thus cutting results from shearing mechanism, this can produce extreme temperature increase in both tooth and bur resulting in a rapid dullness of the carbide bur.

2- The hardness of the carbide bur.
The hardness of the carbide burs (Knoop hardness value= 2500) is lower than diamond burs (Knoop hardness value = 7000)[3], and thus readily dulled during cutting, therefore a significant difference began to appear after cut 7 in subgroup 1 (composite specimen) and after cut 6 in subgroup 2 (amalgam specimen) the differences between the results of subgroup 1 and 2 were attributed to the difference in hardness of amalgam and composite.

Although the carbide CRs were higher than diamond CRs t cut 1 (because of the sharpness of the carbide blades that exceed the diamond points), the carbide CRs were lower than diamond CRs at cut 10 (Since carbide burs readily dulled after cutting). However, there was no significant difference between the mean CRs for all ten cuts of the 4 subgroups, thus both diamond and carbide fissure burs are effective in cutting amalgam and composite materials.

Although, both diamond and carbide fissure burs are effective in cutting amalgam and composite material, still carbide fissure bur less recommended, since it's mechanism of cutting the brittle materials resulted in extremely high temperature, together with the heat that resulted from it's dullness the process will be harmful to the to the vital tooth as well as occupational mercury hazards may result from increased mercury vapor during amalgam removal.

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