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COMPARISION OF CUTTING EFFICIENCY OF TUNGSTEN CARBIDE &DIAMOND BURS ON NICKEL CHROMIUM CASTING ALLOY

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Abstract

Even with the advances in materials and technologies in constructing crown and bridge, failure and the need to replace crown and bridge occurs all the time. When the conservative methods to remove the crown and bridge fail destructive disassembly of the prosthesis has to be carried out. Cutting through the crown with burs is time consuming and tiring.20 metal rods from a base metal alloy (Ni-Cr) rods were used for this study. The rods were divided into two groups .Group A was cut using SSW FG-271 tungsten carbide bur and Group B was cut using SF-11 diamond burs using a high speed hand piece for a constant time of 1 minute by a single operator. The cutting efficiency of each bur was evaluated corresponding to the weight loss.The amount of metal loss was 0.02±0.014 gms with diamond burs and 0.011±.007 gms with tungsten carbide burs.There was a statistically significant difference (<0.05) in the mean material loss between the different groups in independent sample t-test.Cutting efficiency was better with diamond burs.It depends on the diamond bur grit size and duration of the cutting procedure and many other factors. The cutting efficiency of the bur in zirconia and porcelain should also be considered while making the decision.

KEYWORDS: Base metal, Dental burs , Dental casting alloys , Diamond abrasives, High speed handpiece, Tungsten carbide burs

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INTRODUCTION:

Metal ceramic restorations have been available for more than three decades. They have predictable performance and reasonable aesthetics. Even with the advances in materials and technologies in fabricating a crown and bridge occurrences of failure and the need to replace crown and bridge happens from time to time. Failure of crown and bridges occur for a number of reasons . (Giannini & de Andrade, 2020)The tooth holding the crown might fail, fracture of ceramics , incorrect cementation , connector failure , periodontally compromised abutment , fractured tooth structure etc.(Muterthies, 1990)

In cases with failed crowns and bridges, removal of the failed crown and the replacement is indicated . There are many instruments and techniques newly developed for removing the failed crown and bridges which employs percussion or torquing methods .There are limitations to these techniques and they are not always successful as claimed. In those conditions the dentist is left with the option of sectioning the crowns (Sharma et al., 2012). Cutting through the crown with burs is time consuming and tiring. Bur manufacturers have introduced specialised metal cutting diamonds as well as tungsten carbide burs (Watanabe et al., 2000).

The ability of the instrument to remove maximum amount of material with minimum effort and time is the cutting efficiency .The cutting efficiency of tungsten carbide burs depends on various design factors like helix angle, sharpness and number of cutting edges, concentricity and quality of carbide steel (Ohkubo et al., 2006).The aim of this study is to evaluate the cutting efficiency of tungsten carbide bur and diamond burs in sectioning Nickel chromium dental casting.

MATERIALS AND METHODS:

Fig1 Fig2

20 metal rods from a base metal alloy (Ni-Cr) rods were used for this study. The rods were divided into two groups .Each of the metal rods were weighed individually and documented. The rods were rigidly secured with a holding frame.(Fig.1)

Group A was cut using SSW FG-271 tungsten carbide bur and Group B was cut using SF-11 diamond burs using a high speed hand piece for a constant time of 1 minute by a single operator.

The metal rods were weighed after the procedure and they were again weighed. (Fig.2)The data obtained was entered in Microsoft excel spread sheet and the mean difference in weight between the groups were calculated. The data was then entered in the SPSS software and analyzed.

Results:

The amount of metal loss was greater in the group with diamond burs (fig.3) . Statistical analysis was done using SPSS software.The average amount of metal loss (Difference between initial weight and the weight after cutting using dental burs)from each group was measured.The amount of metal loss was 0.02±0.014 gms with diamond burs and 0.011±.007 gms with tungsten carbide burs.(Table 1)Independent sample t-test was carried out for the values obtained from both the groups. There was a statistically significant difference (<0.05) in the mean material loss between the different groups .

TABLE1:AMOUNT OF MATERIAL LOSS

Groups	Metal loss(gms)	P value
Group 1 (Diamond burs)	0.02±0.014	<.05
Group 2 (Tungsten carbide burs)	0.011±.007	<.05

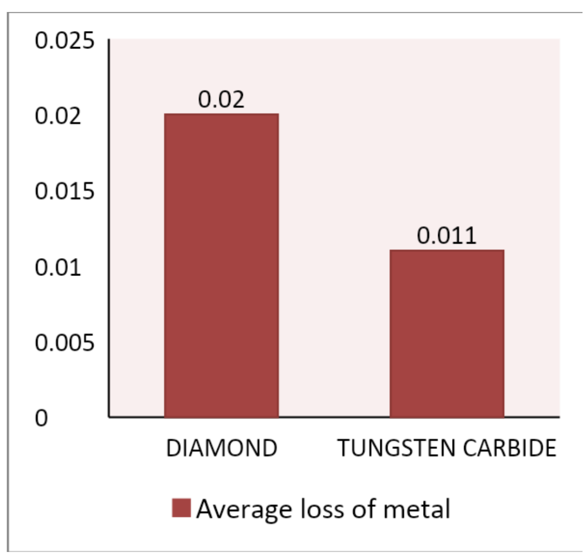

Fig.3 Average loss of metal

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Discussion:

This study showed that the diamond burs are more effective in cutting through nickel chromium alloys in a given period of time when compared to tungsten carbide bur. The results of this study was in contrast to a previous study according to which medium-grit diamond burs should be used to section high noble and noble alloys, but that the cross-cut carbide burs should be used to section base metal alloys (Sharon Crane Siegel & Von Fraunhofer, 2000).

The Sectioning rates of Tungsten carbide burs and diamond burs differed among the alloys. There are many factors that contribute to the overall sectioning rates. With tungsten carbide burs , the hardness of the metal alloy should be lesser than that of the bur used for the burs to efficiently cut the metal (Fraunhofer et al., 2003).Diamond burs have one or more layers of diamond chips attached to the metal head by electro deposition. Because of the differences in the size of the diamond particles diamond burs are available in different coarseness. The grit size of the diamond bur acts as a deciding factor in cutting efficiency (Sharon C. Siegel & Von Fraunhofer, 2002).

This may be because of the use of unused diamond burs; there are studies that indicate the decrease in cutting efficiency of dental burs with multiple uses. The mean cutting rates for all bur types decreased approximately 20% with 20 cuts . There are certain other factors that influence the cutting efficiency of burs such as the amount of pressure, length of bur , Bur type and length of use significantly influenced cutting rateCutting efficiency depends on both the diamond grit of the bur and the load applied to the hand piece and an increased hand piece pressure raises the cutting efficiency of burs (Sharon C. Siegel & Patel, 2016).

Cooling efficiency of the hand piece also influences the cutting rates . The coolants incorporated helps to remove the debris accumulating between the cutting blades as well as between the diamond grits in diamond burs. The coolant also helps in minimising the thermal injury to the pulp. Higher coolant flow rates promote cutting efficiency (Fraunhofer et al., 2000).

The pressure applied while cutting also affects the cutting efficiency of the burs also plays a role in the cutting efficiency .If pressure is applied to the hand piece , cutting efficiency of coarse grit bur was considerably increased. N such changes were observed in medium grit burs (Pilcher et al., 2000). The cutting efficiency also depended on the debris accumulation between the diamond chips. With the accumulation of debris between the chips there was a decrease in the cutting efficiency (Ranganathan & Renukanath, 2017).

With regard to time the efficiency of diamond burs decrease with prolonged usage due to loss of diamond abrasive particles. Sterilisation of the burs and the technique used for sterilisation also influences the cutting efficiency of the burs. With sterilisation using ultrasonic unit loss of diamond grits was greater. With tungsten carbide burs on sterilization with ultrasonic sterilization units there was appearance of pits on the cutting surface due to loss of material .Sectioning efficiency of burs depend on a wide range of factors. It is the dentists call to use which bur for sectioning cast metal restorations.(Gureckis et al., 1991; Park et al., 2006)

The diamond burs sectioned the nickel chromium alloy significantly more efficient than the tungsten carbide bur. Cutting efficiency depends on the diamond bur grit size and duration of the cutting procedure and many other factors. The cutting efficiency of the bur in zirconia and porcelain should also be considered while making the decision (Schuchard & Watkins, 1967).Though there is a decrease in cutting efficiency of diamond burs with prolonged cutting the result of this study shows that a new diamond bur is significantly better in cutting Ni-Cr cast alloy than a new tungsten carbide bur(Hosney et al., 2020) . The limitations in the sample size as well as the fact that most of the factors that influence the cutting efficiency not being maintained as constants may be limiting the outcome of this study.

Conclusion:

This study concluded that the diamond burs are more effective in cutting through nickel chromium alloys in a given period of time when compared to tungsten carbide bur. Using an efficient bur for sectioning the crowns will save a lot of time and energy. To assess the cutting efficiency of different burs elaborate studies are needed to assess the various factors involved in determining the cutting efficiency. All the factors that can influence the cutting efficiency should be assessed . Burs with hardness greater than the metal to be cut should be used.

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