Mystery of the Separating Tungsten Carbide Burs

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Abstract — Three instances of tungsten carbide bur separation, one of which resulted in the patient swallowing the separated bur head are described. This spate of bur heads separating from the shank was associated with a cold sterilising solution used for disinfection.

Introduction

The aspiration or swallowing of dental instruments is not only hazardous to the patient, but can also provide mental anguish and potential litigation to the dentist.

This report presents three instances of bur separation with no immediately apparent reasons. In one instance, it resulted in the patient swallowing the separated bur head.

Case 1

During routine cavity preparation for a Class III composite restoration, the head of Jet carbide bur #330 (Beaver Dental Products, Canada) (Fig. 1) separated from the shank. The separated bur head was retrieved from the cavity and a new bur was used to complete the cavity preparation without further incident.

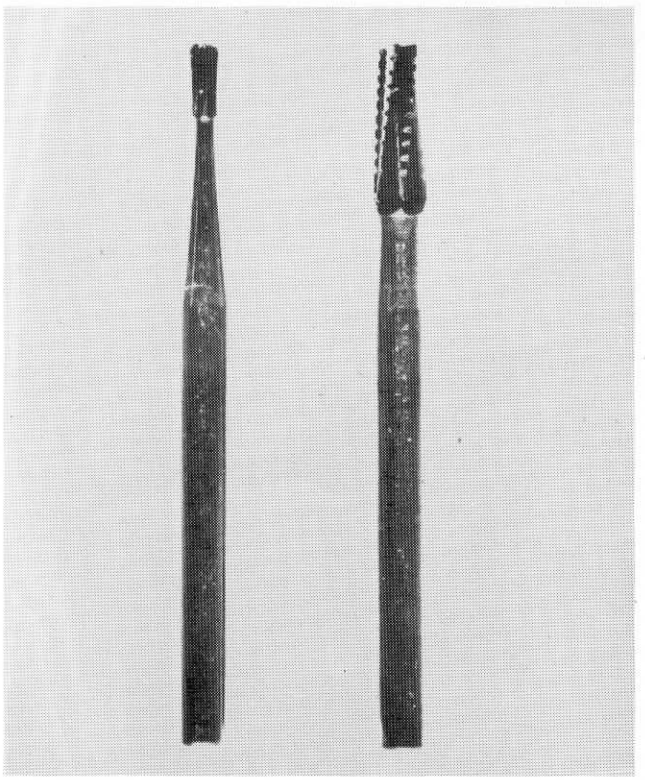

Fig. 1 — Jet Carbide bur # 330 (left) and #720 (right).

Case 2

Two days later, another Jet carbide bur #330 separated while preparing a Class I cavity for an amalgam restoration. The separated bur head landed on the rubber dam and was retrieved. Again, a new bur was used and restorations in that quadrant were completed without further incident.

Case 3

The next day, a large Class II amalgam restoration was to be placed. On contacting the tooth, the bur head of a Jet carbide Bur #702 (Fig. 2) separated immediately from its shank and got lodged in the patient's throat. The chair was put upright from the supine position and the patient tried to cough out the bur head, however, he could not and instead swallowed it. A new bur was subsequently used and the restoration completed without further incident.

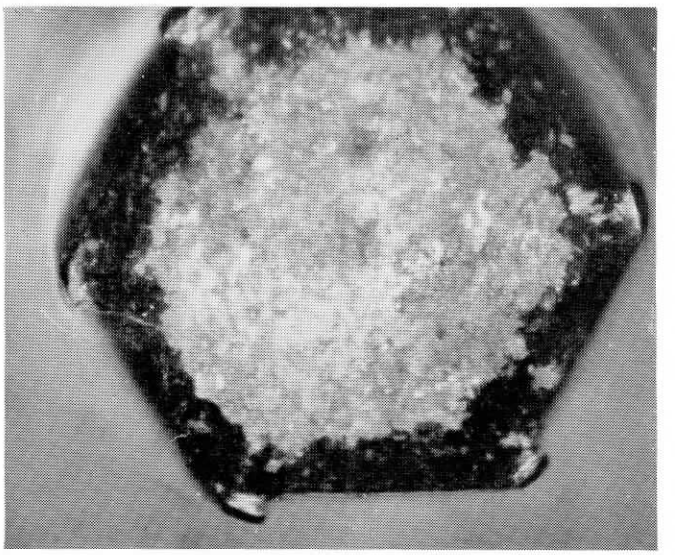

Fig. 2 — Photomicrograph of the separated end of the JET carbide bur #702 showing a peripheral zone of corrosion.

Investigations and Results

The sudden separation of three tungsten carbide burs in such a short period could not be accidental and other factor or factors were probably responsible. The following factors which could potentially cause bur separation were investigated:

1. Excessive lateral pressure on the bur. Normally, a pressure of between 0.56 and 1.11 N is exerted on a friction grip bur running between 300,000 and

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500,000 rpm.[1] According to the manufacturer of Jet burs, Jet carbide burs are made to withstand between 62 and 67 N of side loading. The pressure required to stall any handpiece is lower than that required to cause the bur head to separate from the shank. In none of the three cases, did the handpiece appear to approach stalling before bur separation.

2. Incompatibility between handpiece speed of rotation and tungsten carbide bur. Not all manufacturer's make it readily known that there is a recommended speed range of rotation when using tungsten carbide burs. The maximum speed of the handpiece used, a Bien Air Ondine (Bien Air, Bien, Switzerland) is 400,000 to 430,000 rpm. There was no indication of the maximum speed or the recommended speed range at which Jet carbide burs should be used either in its packing carton or the catalogue. On enquiring from the manufacturer, they stated the recommended speed range is 250,000 to 275,000 rpm.

3. Incorrect sterilisation. The preset instrument trays used were either autoclaved or sterilised in Sporicidin cold sterilising solution (Ash/Dentsply, York, PA, USA), depending on the number of trays requiring sterilisation. If the instruments of the preset tray were cold sterilised, the burs were swabbed with alcohol before they were immersed together with the instruments in Sporicidin solution at 1: 16 dilution for 10 minutes, then rinsed in sterile water as recommended by the manufacturer.

4. Defective batch of tungsten carbide burs. The author has used Jet carbide burs previously and had not experienced bur separation before. This could possibly be a defective batch therefore the shank of the Jet carbide bur #702 from Case 3 which was retained, was sent to its manufacturer for investigation. The photomicrograph of the separated bur shank (Fig. 2) showed evidence that the bur was immersed in or subject to a solution that leached into the weld joint between the carbide bur head and steelplate of the bur shank. This reduced the weld area to cause separation of the bur.

Discussion

It is likely that the main cause of bur separation was weakening of the weld point between the tungsten carbide bur head and the steel shank by corrosion as a result of immersion in Sporicidin cold sterilising solution. Prior to these three instances of bur separation, the burs were not disinfected by immersion in Sporicidin cold sterilising solution. The manufacturer's instructions state that Sporicidin "should not be used as an overnight holding solution for carbon steel and dental burs". In the light of the cause of the corrosion of the tungsten carbide bur weld joint, the dental assistant affirmed that the burs were removed after 10 minutes immersion in Sporicidin, rinsed in sterile water then dried. Each set of burs were immersed probably on two or three occasions only before this practice was discontinued. Even providing for 5 minutes extra per immersion, the burs were immersed at the most 45 minutes, which is far less than "overnight". There were no problems with diamond burs in the set, presumbly because diamond burs do not have weld joints.

The Jet carbide #330 bur is 0.8 mm in diameter while the Jet carbide bur #702 is 1.6 mm in diameter. Weakening of the weld joint by corrosion will affect the narrower weld point of the smaller #330 bur before the larger #702 bur, therefore in these three cases, the #330 burs separated before the #702 bur.

The need to adopt sterilisation procedures which will be effective against bacteria, spores, and viruses, with special emphasis on Hepatitis and Acquired Immune Disease indicate that more practitioners will adopt autoclaving or cold sterilising procedures. There is no doubt as to effectiveness of autoclaving instruments to achieve sterility, however, not all equipment can be autoclaved. Further, when small number of items require sterilisation or disinfection, it is more convenient to cold sterilise.

Like most cold sterilising solutions which are effective against Hepatitis and AIDs, Sporicidin is based on a glutaraldehyde solution. Glutaraldehyde is effective against all micro-organisms, including viruses and spores,[2] however, it can corrode some metals. Therefore, it will be prudent to avoid cold sterilisation of tungsten carbide burs in glutaraldehyde solutions unless there is good evidence that the weld joint will not be affected. Further studies need to be performed to ascertain if other brands of tungsten carbide burs are similarly affected by Sporicidin, or if other cold sterilising solutions affect the strength of the weld joint of tungsten carbide burs. Some cold sterilising solutions contain anti-rust additives, presumably these will be safer to use.

A distinction must be made between disinfection and sterilisation. Some manufacturer's of cold sterilising solutions highlight the speed at which their products work, which is usually a minimum of 10 minutes. It is true that autoclave cycles take longer, but 10 minutes of immersion in cold sterilising solution only produces disinfection, whereas autoclaving results in sterility. To achieve sterility using cold sterilising solutions require between 4 to 12 hours depending on the brand and concentration of the solution.

A disconcerting fact is that the speed of rotation recommended for some brands of tungsten carbide burs are generally low compared to the speeds attainable by modern air-rotor dental handpieces. The maximum speed of the Bien Air Ondine handpiece used is between 400,000 and 420,000 rpm, and that for another very popular handpiece, the Kavo Super Torque (Kavo Dentale, West Germany) is 300,000 rpm. The speed of rotation of these two air-rotor handpieces obviously exceed the recommended speed range for Jet carbide burs (250,000 to 275,000 rpm). The relevance of the recommended speed range is that there is an optimum speed range within which tungsten carbide burs cut efficiently, beyond which efficiency falls off because of wear on the bur.[3] The technology in developing high

speed dental handpieces may have surpassed that in developing dental tungsten carbide burs. According to the manufacturer of jet burs, the maximum speed of rotation is not that important; at higher speeds, less torque can be applied before the handpiece stalls, hence the maximum lateral pressure that can be applied to a bur is inversely proportional to its speed. Hence at higher speeds, the maximum pressure that can be applied on a bur is less than at lower speeds. No other incidence of Jet carbide bur separation has occurred since finding the cause for the three incidents reported, therefore, the speed of rotation at which the bur was used is unlikely to be the main cause of bur separation, although it may have been contributory.

In the interest of safety, manufacturers of tungsten carbide burs should clearly state the bur's recommended speed range or maximum speed of rotation in their catalogues and packing cartons so that practitioners can select the brand or design of bur which is compatible to the speed of rotation of the practitioner's handpiece.

Conclusion

A cold sterilising solution, Sporicidin, was found to be associated with separation of Jet carbide burs.

References

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