VIA MEDICA
ORIGINAL ARTICLE
Vol. 65, No. 1, pp. 34–36

ISSN 0015–5659
www.fm.viamedica.pl

Requirements and infection prophylaxis for internally cooled implant drills

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[Received 21 December 2005; Accepted 8 February 2006]

*Implant site preparation is crucially important to long-term success. Heat generation during drilling is unfavourable, since bone is relatively susceptible to heat, depending on its vascularisation and microstructure. Numerous factors such as drilling pressure, number of revolutions, drill design, wear and material, drilling depth and cooling influence heat generation. Internally cooled drills are, therefore, increasingly used, even though the improved cooling effect compared to conventional externally cooled drills is controversial. Internally cooled drills may have the disadvantage of a germ reservoir developing in the cooling channel. This study aimed to examine the effects of disinfection and sterilisation of internally cooled drills. After contamination of the cooling channel with suitable bioindicators (*Enterococcus faecium*, ATCC 6057 and spores of* Bacillus stearothermophilus, *ATCC 7953), the drills were disinfected (disinfection solution ID 220, Dürr Dental) and autoclaved (Webeco, E5S90, 134°C, 2.6 bar, 5 min). Disinfection was not completely effective except after pre-cleaning. By means of sterilisation all spores of* Bacillus stearothermophilus *were completely killed. Internally cooled drills can be successfully disinfected by means of this hygienic procedure routinely used in dental practice and no source of infection is created.*

Key words: drills with internal cooling, disinfection, sterilisation

INTRODUCTION

Surgical implantation technique is of major importance for the osseointegration and long-term success of dental implants. Avoiding heat damage to the surrounding bone tissue during implant bed preparation is imperative, as regenerative processes in the bone are prohibited or retarded. Bone is relatively susceptible to heat, with the degree of vascularisation and the microstructure playing an important role. In principle, the more vascularised spongy bone leads off heat better than compact bone [8]. Even temperatures not exceeding 47°C may generally produce bone necroses [4–6]. Heat development during implant bed preparation depends upon numerous factors, such as drilling pressure, number of revolutions, drill design, wear and material and drilling depth [2]. Moreover, cooling during implant bed preparation and the cooling effect within the bone is essential [11]. Beside conventional drills with external cooling, there are drills which directly conduct the cooling fluid

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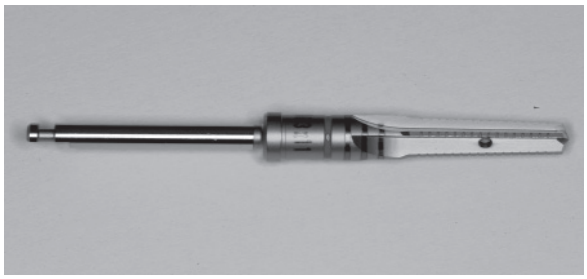

Figure 1. Form drill (Camlog®, diameter 4.3 mm, length 11 mm, internally cooled).

through an internal channel close to the drill head in order to achieve more effective cooling within the bone (Fig. 1). However, the advantage of internal cooling is a subject of controversy [1]. Possible disadvantages of drills containing an internal cooling channel are reduced stability with increased risk of breakage on the one hand and soiling with clogging of the irrigation channel on the other. These, however, have not been confirmed by our usage. The narrow winding rinsing channel may produce a germ reservoir (Fig. 2). This study aimed to examine the effectiveness of dental disinfection and sterilisation in germ-contaminated irrigation channels of form drills (Camlog®, diameter 4.3 mm, length 11 mm).

MATERIAL AND METHODS

Trial 1

Fifteen unused sterilised form drills with internal cooling (Camlog®, diameter 4.3 mm, length 11 mm) were rinsed and contaminated through the cooling channel with a 2 ml suspension of blood and the test germ *Enterococcus faecium* (ATCC 6057) at a concentration of 10^6 germs per ml. Five drills respectively underwent either mechanical pre-cleaning of the cooling channel using brushes prior to immersion in the disinfecting solution (ID 220, Dürr Dental), or immersion in a drill disinfecting solution (ID 220, Dürr Dental) without pre-cleaning or served as controls without any disinfection. After the recommended minimum residence time of 20 minutes the drills were taken out of the solution and dried, and microbiological specimens were sampled from the rinsing channel.

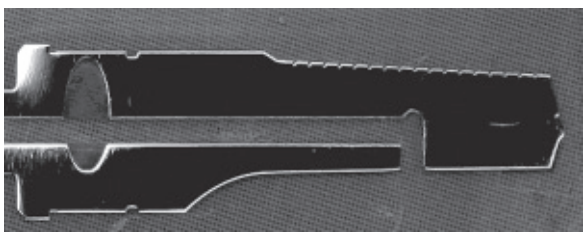

Figure 2. Form drill (Camlog®, diameter 4.3 mm, length 11 mm, internally cooled). Thin-section showing the cooling channel.

Trial 2

In a second trial, 15 unused sterilised form drills with internal cooling (Camlog®, diameter 4.3 mm, length 11 mm) were contaminated through the cooling channel with a 2 ml suspension of saline solution and spores of *Bacillus stearothermophilus* (ATCC 7953) at a concentration of about 10^6 spores per ml. Then ten drills were sterilised using an autoclave (Webeco, E5S90) at 134°C and 2.6 bar for 5 minutes, while five drills served as controls and were not sterilised. Subsequently microbiological samples collected from the internal irrigation channel of each drill were analysed.

RESULTS

The specimens from both trials were incubated in a soybean-casein-peptone broth at 37°C for seven days. Subsequently dilution series of the single samples were prepared, pour-plated on a soybean-casein-peptone agar and analysed.

Trial 1

Contamination proved successful in all five controls on the evidence of the test germ *Enterococcus faecium* (ATCC 6057). In the mechanically pre-cleaned drills effective germ reduction by more than 8 log steps was observed, while in the group without pre-cleaning a reduction of only four log steps was achieved in three out of five specimens.

Trial 2

Contamination proved successful in all five controls on the evidence of *Bacillus stearothermophilus* (ATCC 7953). Following sterilisation all 10 samples analysed showed absence of contamination. Thus this routine sterilising procedure can also be considered effective for contamination with spores in the cooling channel.

DISCUSSION

The rising prevalence of blood-transmitted diseases over the last 20 years may not only be ascribed to more accurate and area-wide diagnostic assessment but also results from an actual increase in infections. Effective and safe infection prophylaxis is, therefore, essential, particularly in oral surgery [3]. Immersion of dental instruments in special disinfection solutions and subsequent steam sterilisation using an autoclave

Figure 3. Form drill (Camlog®, diameter 4.3 mm, length 11 mm, internally cooled). Thin-section 2.5 × showing the cooling channel port.

is a hygiene procedure used in most dental practices [9]. An advantage of this procedure is that it is simple, inexpensive and quick to operate, while the effectiveness of disinfection and sterilisation is questionable in narrow lumina or small gaps and hollow spaces, particularly when these are additionally contaminated with organic material. It is common, therefore, to pre-clean and dismantle dental instruments as far as possible, which is not feasible for drills with an internal cooling channel (lumen diameter about 600–800 μm, Fig. 3). The number of bioindicators used in these trials for contamination of the cooling channels of implantological form drills exceeds the number of micro-organisms found on surgical instruments during clinical routine use [10]. Thus it can be assumed that the hygiene measures utilised are sufficient for clinical use. Furthermore, the spores of *Bacillus stearothermophilus* (ATCC 7953) used to test sterilisation effectiveness are among the heat resistant bacteria spores. Successful killing of these spores, therefore, suggests that all other microbes have already been eliminated [7]. Trial 1 shows that the effectiveness of disinfection is complete only after mechanical pre-cleaning. Sterilisation according to the frequently used routine programme (134°C, 2.6 bar, 5 min) is also fully effective within the inner cooling channel of drills with an internal cooling system.

CONCLUSION

The treatment of internally cooled drills by means of the disinfection and sterilisation procedures commonly used in dental practice is problem-free and safe. Mechanical cleaning of the cooling channel before immersion in a disinfection solution is to be recommended. After proper sterilisation, internally cooled drills do not pose an infection risk.

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