Original Research

Effectiveness of Bench Top Non-Vacuum Autoclaves on Dental Turbine Chamber Sterilization

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Abstract

Introduction: Dental turbine chamber is a suitable reservoir for living microorganisms, so chamber sterilization is necessary for reducing cross contamination risk. On the other hand, in non-vacuum autoclaves, steam penetration into turbine chamber is doubtful, while they are still in use in dental clinics. In this study, performance of small non-vacuum autoclave in turbine chamber sterilization was evaluated. **Methods:** A total of 48 dental turbines were sterilized by large vacuum autoclaves. The turbin chamber cap was opened in aseptic enviroment and a strip contaminated with bacillus stearothermophilus endospores was placed into chamber and chamber cap was closed. Twelve dental turbines were loaded in each of four autoclaves (2 large pre-vacuum autoclaves, 2 bench top non-vacuum autoclaves) and sterilization process preformed according to the manufacturer's instructions. After the sterilization cycle, the strips were transferred to culture medium and incubated at 56°C for 48 Hours. As control sample, a biologic indicator that had not been autoclaved was used for each group. **Results:** Being loaded in different autoclaves, All 48 turbines were sterilized properly and all the cultures were negative. The culture results of four control indicators which were not sterilized, were positive. **Conclusion:** There was no difference between performance of vacuum and non-vacuum autoclaves in dental turbine chamber sterilization. Both types performed sterilization properly.

Key Words: Autoclave, dental turbine, sterilization, vacuum.

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Introduction

Dental health care personnel and their patients are exposed to wide range of pathogens (1,2). Because of cross contamination risk through dental turbine chamber, the chamber sterilization is essential (3-8). Sterilization by water steam heat is one of the most practical and fastest ways of medical instrument sterilization, performed by autoclave in high pressure and high temperature (2,9,10). The important point in this method is direct contact of steam with contaminated surfaces and steam penetrating into interior spaces of the instrument (10).

Autoclaves are classified to negative (with vacuum mechanism) and positive pressure displacement type (without vacuum mechanism). Negative pressure displacement type has a vacuum pump that vacuums the air from autoclave chamber; therefore steam can penetrate more efficiently. A few years ago, the most of clinical autoclaves had no vacuum mechanism (11).

Although it was suggested that autoclaves with a vacuum mechanism sterilize better than the other types (2,3,12), but non-vacuum autoclaves are still in use. Therefore, it is necessary to evaluate the efficiency of different types of autoclaves available in dental schools and clinics for turbine chamber sterilization.

The aim of this study was to assess the efficiency of non-vacuum autoclaves available in Mashhad Faculty of Dentistry, Mashhad, Iran.

Materials and Methods

In this in vitro study, 48 dental turbines (Cmomek 300-05-B2, Russia) available at Mashhad Faculty of Dentistry were examined. Self-contained biological indicator (EZS-5 model, EZtest, SGM-biotech Company, USA) was used to evaluate the efficiency of autoclave sterilization process. Components of biological indicator were a plastic vial, a paper strip inoculated with 2.2×10^5 $^{spores}/_{unit}$ of bacillus stearothermophilus, and crushable glass ampoule, which contained culture medium. Four autoclaves were used to sterilize turbines: two large vacuum autoclaves (JLAC 300, Sazgar, Tehran, Iran) and two small non-vacuum autoclaves (Prestige Medical 2100, UK and Prestige Century 2, UK).

All turbines were cleaned and lubricated according to CDC guideline, and divided randomly into 4 groups (12 in each). Each group were placed on a metal tray and packed with standard fabric cover. All turbines were sterilized with a large autoclave (JLAC 300, Sazgar, Tehran, Iran) at 121°C and 15 psi pressure for 15 minutes. At the next step, packs were opened in an aseptic environment. Each turbine`s cap was removed with a sterile wrench and a paper strip containing spores was placed inside chamber with sterile pence and cap was closed. Each 12 turbines were placed on a metal tray and packed again. Each pack was placed randomly into one of four autoclaves and sterilization process was preformed according to the manufacturer's instructions.

After sterilization, the paper strip was removed from turbine chamber with sterile pence and cautiously placed inside the plastic vial. The ampoule containing culture medium was broken inside container therefore strips were in contact with culture medium. For each pack, one biological indicator that had not been autoclaved was considered as control. All vials were incubated at 56°C for 48 hours. The color of culture mediums were assessed after 48 hours. The primary color was violet and its change to yellow was indicative of a positive reaction.

Results

The results of cell culture were as follow:

1. In sterilization using large vacuum autoclaves results of cell culture were 100% negative.
2. In sterilization using bench top non-vacuum autoclaves results of cell culture were 100% negative.
3. The results of four control samples that had not passed sterilization cycle were positive.

All four autoclaves sterilized turbine chamber properly and all endospores of bacillus stearothermophilus were eliminated. There was no difference in function of vacuum and non-vacuum autoclaves in turbine chamber sterilization. We had decided to analysis data using ANOVA or Kruskal–Wallis tests. The cell culture datas were 100% negative in both experimental group, therefore statistical analyses were not required.

Discussion

Present study assessed sterilization of dental turbine chamber with non-vacuum autoclave. Based on findings the small bench top non-vacuum autoclaves were as effective as large vacuum autoclaves in sterilizing dental turbine chamber. Many previous studies in this field evaluated turbine contamination during dental procedures (3-8). Lewis et al. (4) study confirmed oral fluid retraction into the turbine chamber during dental procedures. Bagga et al. (5) also showed that each time turbine stops while it is still in the patient's mouth, about 1ml oral fluids, that contained 54000 microorganisms, may be aspirated into turbine chamber. Based on previous studies turbine chamber contamination during dental procedures is inevitable and can cause cross-contamination (3-8). The number of studies that evaluated effectiveness of bench top autoclaves, which are common in dental clinics, in sterilization of instruments with lumens and cavities like turbines, are limited (3,13). Andreson et al. (3) in 1999 reported that only vacuum autoclaves were able to sterilize turbine chamber 100%, while the sterilization of turbines that were sterilized in non-vacuum autoclaves, were not acceptable . These results were different from our findings. In their study turbines that were cleaned before placing in non-vacuum autoclaves, were sterilized properly while thoes that were not cleaned before the process, failed to sterilize. Anderson concluded that cleaning turbines before sterilization is necessary. We cleaned all the turbines before putting them in autoclaves. In Anderson et al. (3) study, sterilization in

two models from four models non-vacuum autoclaves was incomplete. In present study, all pre-vacuum and non-vacuum autoclaves were able to sterilize turbine chamber properly.

Edwardson et al. (14) studied the effect of using lubricant in turbines before sterilization. Based on their results autoclave alone may not be able to sterilize turbines appropriately, but using antibacterial lubricant before putting turbines in autoclave can solve the problem. Although we used lubricant without antibacterial material before placing turbines in autoclave, turbines were sterilized properly.

Similar to current study in Zeng et al. (13) study, all the turbines were sterilized appropriately. They used small pre-vacuum autoclaves, while we used small non-vacuum autoclaves. There is no debate about performance of pre-vacuum autoclaves, and more evaluation seemed to be unnecessary. Nevertheless, there is cautious about performance accuracy of non-vacuum autoclaves. Two small non-vacuum autoclaves, which were examined in this study, were able to sterilize turbine chamber 100%.

Conclusion

Based on present study, bench top non-vacuum autoclaves were as effective as large pre-vacuum autoclaves in dental turbine chamber sterilization. It could be suggested that in future studies sterilization of narrow water and air ducts of dental turbines by bench top non-vacuum autoclaves be evaluated.

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