To Compare the New Method of Sterilization of Endodontic Instruments with Autoclave: An In Vitro Study

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Abstract
Sterile instruments are prerequisite for dental procedure. Autoclave is the conventional method of sterilization. Since autoclave is cumbersome and time consuming procedure there exists a need for a new protocol and a device. This device should facilitate the clinician to accomplish the cleaning and sterilization procedure in the short span of time (5-10 min) and should be done in the dental operatory itself. Thus, a new device was prepared that suffices all the above said advantages. In the present study, efficiency of the new device was compared with that of autoclave, using culture method. It was concluded that its efficacy was equal to that of autoclave. Considering the time consumed by both the methods, cleaning followed by autoclave require 20-30 minutes whereas, the new method require 5-15 min. Also the novel method can be done chair-side in between two consecutive appointments. Thus this new device can help the clinician to work more efficiently in aseptic conditions.

Citation:

1. Introduction
Infection control and sterile armamentarium is the most important procedure in health care services, and endodontic therapy is not apart from it. In absence of adequate infection control procedures, there is a realistic potential to transmit pathogenic microbes via endodontic instruments. (Eldik et al., 2004) Endodontic instruments should be sterilized before every use. (Eldik et al., 2004, Morrison et al., 2009, Reams et al., 1995, De Sousa et al., 1999, Rutala et al., 2008, Venkatasubramanian et al., 2010) though autoclaving is the best proven method of sterilization, it is cumbersome and time consuming and cannot be performed recurrently. However, patient receiving hygienic condition cannot be overlooked. Hence, there is a need for the development of a procedure and equipment which suffices the purpose of sterilization, in between two appointments and that can be used chair-side (Morrison et al., 2009).
1.1 Review of literature
Singh et al. (1989) proved that NiTi implants can be sterilized using UV Light for 20 sec.

Eldik et al. (2004) compared various methods of cleaning and sterilization of endodontic files and concluded that Steam sterilization eliminates all bacteria from the endodontic files irrespective of the presence of biological debris.

Da Silva et al. (2007) stated that Sterilization of the contaminated endodontic files using either wet or dry heat eliminated bacterial endotoxin.

Morrison et al. (2009) stated that endodontic files, as packaged by the manufacturer, are not sterile and should therefore be sterilized before first use. The author also has stressed the need for better and more rigorous sterilization procedures. If such procedures cannot be devised, these instruments should perhaps be considered single-use devices.

Venkatasubramanian et al. (2010) compared 4 methods of sterilization of endodontic files and concluded that files sterilized by autoclave and laser were completely sterile, by glass bead sterilizer were 90% sterile and those with glutaraldehyde were 80% sterile.

1.2 Objective of Research
The new device is prepared with a vision to facilitate a dentist to sterilize the endodontic instruments (files) within few minutes. Factors like time required and need of separate sterilization room can prohibit a dentist from using autoclave after every procedure. This can have an impact on the cost factor invested by the dentist as more number of files will be needed. The newly introduced protocol and the designed device provide a paramount for reuse of files by sterilizing it within few minutes. This procedure allows the clinician to sterilize the used files in the time span one’s operatory is getting ready for the next patient. Also the procedure can be done chair-side.

2. Experimental
2.1 Proposed protocol for cleaning and sterilization
The proposed new method is elaborated as initially the files were soaked in gauze square for maximum 10 minutes followed by ultrasonic cleaning (Dietz-Bourguignon et al., 2002) (1 cycle for 180 sec) then placed in endo-box and steam sterilization (121°C at 15lb for 15 min)

Group III The files were cleaned and sterilized by new proposed method.

No cleaning

Group II The files were cleaned by soaking in gauze maximum for 10 min followed by ultrasonic cleaning (Dietz-Bourguignon et al., 2002) (1 cycle for 180 sec) then placed in endo-box and steam sterilization (121°C at 15lb for 15 min)

Group I: Files were not cleaned by any means and directly sent for culture.

2.2 Method to evaluate efficacy of new protocol and the proposed device
Total 30 used #15 to #25 (25 mm length) k-files were collected from the Department of Conservative Dentistry and Endodontic V.S.P.M D.C.R.C and divided into three equal groups (10 in each)

2.3 Method to evaluate efficacy of new protocol and the proposed device
Total 30 used #15 to #25 (25 mm length) k-files were collected from the Department of Conservative Dentistry and Endodontics V.S.P.M D.C.R.C and divided into three equal groups (10 in each)

Figure 1:

Figure 2:
2.4 Culture of collected samples
The samples were vortexed for one minute to dislodge the biological debris from the files and disperse the bacteria in the transport medium. The aerobic culture was inoculated on Blood agar and McConkey agar. The plates were inoculated at 37°C aerobically up to 48 hours. The number of colonies was noted and the growth was identified by growth characteristics, Gram stain and relevant biochemical tests.

The anaerobic culture was inoculated on blood agar and incubated in anaerobic jar at 37°C up to 72 hours. The number of colonies were noted and the growth was confirmed by gram staining and aerotolerance test.

3. Results

Table 1:

<table>
<thead>
<tr>
<th>S.N</th>
<th>Group Ia</th>
<th>Group Ib</th>
<th>Group IIa</th>
<th>Group Iib</th>
<th>Group IIIa</th>
<th>Group IIIb</th>
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</tr>
</tbody>
</table>

* Number signifies colony count in each cultured sample

Control group with no cleaning or sterilization (Group I) showed microbial growth. Both the experimental groups (Group II & III) did not show any growth in both aerobic and anaerobic culture. This proved that efficacy of new proposed method is equal to that of autoclave.

4. Discussion

Autoclave is the most commonly used method (Rutala et al., 2008) for sterilization, but it is cumbersome and time consuming and cannot be done after every use. This article aims to introduce a new method for sterilization of endodontic instruments that can meet the standard guidelines, is easy, quick and can be done chair-side in-between two appointments. The new proposed method include presoaking of the file was done for maximum 10 minutes followed by ultrasonic bath. Ultrasonic bath is faster and easier method of cleaning endodontic files when compared with manual technique. (Reams et al., 1995; De Sousa et al., 1999) Cavitation activity of ultrasonic bath along with chemical activity of the detergent (ultrasonic cleaning solution) helps to remove biologic debris. (Ziauddin et al., 2013) The Australian/New Zealand Standard AS/NZS 4187:2003 stipulates that instruments should be...
‘clean to the naked eye (macroscopic) and free from any protein residues (Parashos et al., 2004)’. Thus complete cleaning was done before sterilization in both the groups.

UV Light is commonly used as surface disinfectant. The wavelength of UV radiation ranges from 328 nm to 210 nm (3280 Å to 2100 Å). (Rutala et al., 2008) Its maximum bactericidal effect occurs at 240–280 nm. The UV rays can kill only those microorganisms that are struck directly by UV light beams. For surfaces that cannot be reached by the UV rays, any microorganisms present will not be killed. But in case of endodontic instruments the diameter of the instrument per se is small, also its design permits more surface area to come in contact with the light source. For this reason it was believed that UV Light can sterilize endodontic instruments. Inactivation of microorganisms results from destruction of nucleic acid through induction of thymine dimmers. (Rutala et al., 2008)

The results showed that efficiency of new device is equal to that of autoclave. Considering other parameters (as discussed below), the new sterilizer has an upper hand especially for endodontic files.

Conclusion

Based on the new method proposed above, a device was prepared that suffices the purpose of sterilization of endodontic files. It can be concluded that this is an inventive step to enhance the quality of work done by a dental professional. This can help the clinician to sterilize the endodontic instruments chair-side within few minutes. This experiment can provide a new sterilization unit to the global dental market and thence, can be named as ‘TURRANTRoCaES’ (Shah et al. 2013).

Research Highlights

**Advantages of the device (Shah et al., 2013)**

- Less time consuming
- No corrosion (as no moist heat)
- Portable & Compact
- Cleaning and sterilization both procedures provided in one single compact device
- Easy to use
- Can be used chair-side
- Can be used in-between two consecutive appointments

**Comparison of autoclave and new device**

<table>
<thead>
<tr>
<th>S.N</th>
<th>Feature</th>
<th>Autoclave system</th>
<th>New device</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic Principle</td>
<td>Steam under pressure</td>
<td>Ultraviolet Light</td>
</tr>
<tr>
<td></td>
<td>Time consumed</td>
<td>20-30 min</td>
<td>5-15 min</td>
</tr>
<tr>
<td></td>
<td>Accessories for cleaning instrument prior to sterilization</td>
<td>Required</td>
<td>Not required</td>
</tr>
<tr>
<td></td>
<td>Accessories for sterilization protocol</td>
<td>Required</td>
<td>Not required</td>
</tr>
<tr>
<td></td>
<td>Efficiency</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Damage to NiTi files</td>
<td>Reduce the cyclic fatigue (but clinically not significant)</td>
<td>No damage</td>
</tr>
<tr>
<td></td>
<td>Disadvantage</td>
<td>Time consuming</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advantages</td>
<td>Efficiency is 100%</td>
<td>Efficiency 100%</td>
</tr>
<tr>
<td></td>
<td>Maintenance</td>
<td>Cumbersome</td>
<td>Compact and easy to use</td>
</tr>
<tr>
<td></td>
<td>Customized designing</td>
<td>Not possible</td>
<td>Cleaning and sterilization process all in one device</td>
</tr>
<tr>
<td></td>
<td>Biological safety</td>
<td>Safe</td>
<td>Less time consuming</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cost effective</td>
</tr>
</tbody>
</table>
**Safety features of the device (Shah et al., 2013)**

Made up of stainless steel so that UV rays do not transmit through it. Also the file holder or stand is made of stainless steel to ensure minimal or notransmission of light.

Rubber tubing and proper lock to create vacuum.

**Limitations**

In the current study, only aerobic and anaerobic culture was done so as to check the efficiency of the new prepared device. For further authentication of the device, killing of spores should be checked using biological indicator. (This work is in progress).

**Recommendations**

Further there is a need to check the efficiency of new device using *Bacillus pumilus* spore strips.

**Funding and policy aspects**

Author is searching for manufacturer who can promote the instrument in market.

**Authors’ Contribution and Competing Interests**

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**Message for readers**

Anyone interested in manufacturing of the said device should contact on drnomalshah@gmail.com

**Acknowledgment**

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**Note:**

All the intellectual property rights are reserved. The study and design of the device are already patented.

**References**


Dietz-Bourguignon E., Raula Cathy L., Esperti (Editor) 2002, b Safety standards and Infection Control for Dental Hygienists, Thompson Learning, Chapter 8, 129.


