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RESEARCH ARTICLE

AN IN VITRO EVALUATION OF THE EFFECT OF AUTOCLAVE STERILIZATION ON FRACTURE RESISTANCE OF BIOLOGIC POSTS

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ABSTRACT

Aim To evaluate the effect of autoclave sterilization on fracture resistance of biologic posts used in conjunction with restorative composite core.

Materials And Methods Root canal treatment was performed on 40 maxillary central incisors. Post space was prepared and samples were divided into four groups of 10 each. The teeth were inserted with prefabricated biological post prepared from 20 canines. 20 biological posts were prepared from 10 canines, half (10 posts) of them were sterilized in autoclave for 40 mins. 20 sections were obtained from other 10 canines, half of them were sterilized and remaining sections were unsterilized. Posts were fabricated and cemented using adhesive resins and core was fabricated with restorative composite material. Fracture load was evaluated using universal testing machine at a cross head speed of 5mm/min. Fracture above the embedded resin was considered favourable and fracture below the resin level was considered unfavourable. The results were analyzed using ANOVA and unpaired't' test.

Results There was no significant difference between fracture resistance of sterilized and un sterilized biological post groups.

Conclusion Within the limitations of the study autoclaving does not influence on the fracture resistance of biologic posts in conjunction with composite core build up.

INTRODUCTION

Over the past two decades, dentistry has achieved great scientific and technological advances regarding restorations and adhesive materials. However, a proper coronary reconstruction of endodontically treated tooth is still a challenge for restorative dentistry. Better intracanal retention and stability of coronal restoration can be achieved by using posts made from different materials such as fiberglass, carbon fiber, metal and ceramic. But no commercially available posts meet all ideal biological and mechanical properties.[1] However; none of the restorative material has ever been more effective than the natural dental structures. Hence several authors suggested the use of natural teeth fragments as an efficient method for restoring fractured anterior teeth.[2,3,4] Fragment reattachment using natural teeth is a technique known as "Biological Restoration" and provides excellent results regarding surface smoothness, esthetics, and the maintenance of the incisal guide in dental structures that cause physiological wear.[3]

The use of "biological posts" made from extracted tooth presents a feasible option for strengthening of root canal. Potential advantages of biological posts are:1) It reduces dentinal stress, 2) Preserves the internal dentinal walls of the root canal, 3) Offers excellent adhesion to tooth structure and composite restorations.[2] The pulp and periradicular tissues of extracted teeth are loaded with a number of viable viruses, bacteria and their toxins which may act as a potential source for infectious diseases.[4] There are various methods available for sterilization / disinfection of extracted teeth, such as autoclaving, dry heat, ethylene oxide sterilization, gamma radiation and chemicals.[5,6] Gamma radiation sterilizes the teeth and endodontic filling material without altering the structure and function of dentin.[7] However, gamma radiation requires expensive equipment, which is not readily available. Chemicals like 2.6% sodium hypochlorite, 3% hydrogen peroxide and boiling water were not effective for disinfecting teeth. [8]

It is important to note that, before the manipulation of any of the extracted dental elements, the teeth were properly cleaned, stored, and sterilized by autoclaving at 121°C for 15 minutes, ensuring all biosecurity standards.[2,3] Autoclaving is a commonly used method of sterilization. Clinicians have been using biological restorations fabricated from donor teeth after autoclaving at 121° C for 15 mins. [2] Autoclaving of extracted teeth at 121°C and15 lbs pressure for 40 minutes was 100% effective in preventing microorganisms.[5,7] However, little work has been done on the effect of autoclave sterilization on the fracture resistance of biologic post. So this study was aimed to evaluate the effect of autoclave sterilization on fracture resistance of biologic posts used in conjunction with composite core.

MATERIALS AND METHODS

Sample Preparation

Extracted 40 human maxillary central incisor and 20 canines' teeth were selected, cleaned and stored in physiological normal saline for 24 hours. Teeth that were free of caries, cracks and previous restorations were selected. Any handling of teeth was done by protective gloves, mask and protective eye wear. The crowns were removed at cemento-enamel junction and all the roots were adjusted to 10 mm from root apex. The patency of the apical foramen was determined with a size 15 – k file. Root canals were instrumented to a size 40 – K file and sectional obturation of 4mm was done with 40 Gutta percha cones using resin sealer. Post space preparation was performed using DT light post drill of 6 mm (size 3). Throughout the instrumentation, 5.25% sodium hypochlorite was used for irrigating the root canals and a final rinse was done with 17% EDTA in order to remove the smear layer. Finally root canals were flushed with saline solution and dried with paper points and divided into four groups of 10 teeth each.

Preparation of Biological Post

20 extracted human permanent maxillary canines were selected, cleaned and stored in physiological normal saline until required. Teeth were divided into 2 groups (A & B) of 10 teeth each. After the crown portion was separated from a portion of the root by using a diamond disk. 20 root sections were obtained by sectioning mesio distally along the long axis of the tooth in each group. From group A, 20 posts were prepared according to the dimensions of DT light post no:3 i.e apical diameter of 1.2mm and coronal diameter of 2.2 mm . Half (10 posts) of them were sterilized in autoclave for 40min at 121^0c and 15 lbs pressure and another half of them were un sterilized. In group B, 10 sections were sterilized in autoclave for 40min at 1210c and 15 lbs pressure and another half of them were UN sterilized. Each section of the root was cut in such a way as to form "Biological Posts."

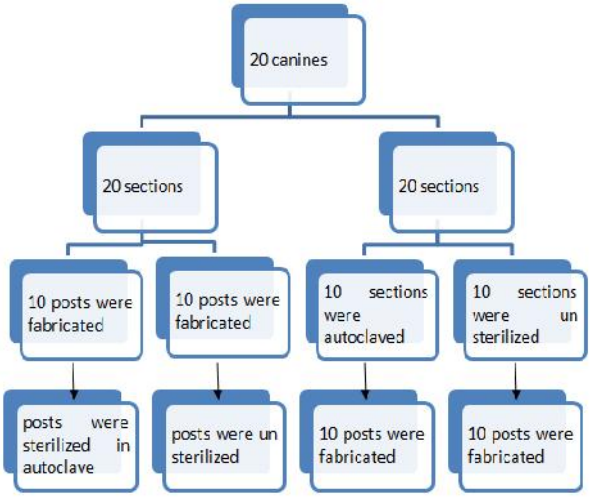

Figure 1

Grouping Of Teeth and Post Insertion

The post space preparation was completed in the 40 central incisors with the corresponding drill provided by the manufacturer. These samples were divided into four groups, 10 each.

- Group 1: The sterilized posts prepared from extracted canines were inserted into the post space.
- Group 2: The unsterilized posts prepared from extracted canines were inserted into the post space.
- Group 3: The posts prepared from sterilized vertical sectioning of extracted canines were inserted into the post space.
- Group 4: The posts prepared from unsterilized vertical sectioning of extracted canines were inserted into the post space.

All these 4 groups were cemented with self adhesive self cured dental resin cement (Multilink speed, Ivoclar Vivadent, USA.). Core build of post with a dimension of 4 x 1.5mm was done with nano filled composite restoration (Tetric – N – Ceram, Ivoclar Vivadent). Cylindrical moulds of 15 mm in diameter and 20 mm in length were prepared using cylindrical tubes and self cure acrylic was placed in the mould and apical 8 mm of the root were embedded leaving 2mm remaining root exposed.

Investigation of Fracture Resistance

A compressive load at a crosshead speed of 5 mm/min was applied using a universal loading machine at an angle of 130° to the long axis of the tooth. The load at fracture was measured and the mean was calculated using statistical analysis of analysis of variance (ANOVA) and Unpaired't' test the significance among the four groups was analyzed.

To Investigate the Mode of Failure

Tooth fracture was either classified as favourable or unfavourable according to its location. Fracture above the embedded resin was considered favourable and fracture below the resin level was considered unfavourable. It was noted by two independent observers.

RESULTS

Fracture resistance

The results were analyzed using analysis of variance (ANOVA) and unpaired't' test. The mean fracture load value of group 2 (94.13 N) was higher compared to group 1 (88.72N) but there was no statistical significant differences observed. The mean fracture load for group 4 (72.97N) was higher compared with group 3 (65.97N) but there was no statistical significant differences was observed.

Mode of fracture

According to location, tooth fracture was tabulated favorable or unfavorable.

- Fracture above the embedded resin - favorable
- Fracture below the resin level - unfavorable

Table 1 Mean fracture load of sterilised and UN Sterilised before and after sectioning

GROUP	N	MEAN	SD	F -VALUE	P-VALUE
1	10	88.72	11.996	0.709	0.411 (Ns)
2	10	94.13	16.403		
3	10	65.97	9.896	2.638	0.122 (Ns)
4	10	72.98	9.400		

Ns-no significant difference

Table 2 Inter group comparisons of mean fracture Load of sterilised and un sterilised biological posts (UNPAIRED -T –TEST)

SAMPLE	T- VALUE	P-VALUE	SIGNIFICANCE
GR 1 & 2	0.841	0.410	Ns
GR 3 & 4	1.024	0.121	Ns

Ns-no significant difference

Table 3 SHOWING MODE OF FRACTURE

Fracture	Group 1	Group 2	Group 3	Group 4
Favorable	10	10	10	10
Unfavorable	0	0	1	0

DISCUSSION

Clinicians have used biologic restorations as an alternative for reconstruction of extensively damaged tooth to provide highly functional and esthetic outcomes. There exists a definite correlation between post material and fracture of roots. The post material should have the same modulus of elasticity as the root dentin to distribute the applied forces evenly along the length of the post and the root. Studies have shown that when a system with components of different rigidity was loaded, the more rigid component was capable of resisting forces without distortion. The less-rigid component fails and relieves stresses.[1] Post with modulus of elasticity significantly greater than that of dentin might create stresses at then tooth/cement/post interface, with the possibility of post separation and failure. Modulus of elasticity of dentin was approximately 14–18 GPa. The adhesion provided among the biological post, the cementing agent, and the dental structure allows one to attain a sole biomechanical system (monoblock) with materials that are compatible among themselves. The use of biological posts made from natural, extracted teeth represents a feasible option for the strengthening of the root because of its good adherence property and by reducing dentin stress.[2,3,8,9,10]

In this study, autoclave sterilization was used to sterilize the extracted natural teeth to prepare biologic posts and prepared biological posts. Studies have reported that autoclaving extracted teeth for 40min at 121^0c and 15 psi renders them free of microbial organisms.[5,6] The fracture resistance was evaluated using a universal load-testing machine. A compressive load at a crosshead speed of 5 mm/min was applied at an angle of 135° to the long axis of the tooth. Although, clinically, the velocity of mandibular movement varies considerably, the impact velocity of the compressive tip was maintained at a crosshead speed of 5 mm/min, which is considered as an acceptable average value.[6]

The primary mode of failure was evaluated at the above mentioned fractured loads. The level of embedding of the tooth sample in the auto polymerizing resin was 3 mm below the cemento-enamel junction, which simulated the level of alveolar bone. The mode of failure was considered favourable or unfavourable depending on whether the fracture of the tooth sample was above or below the embedded resin, respectively. Fractures above the embedded resin were considered favourable as retreatment could be initiated due to the accessibility and the adequate amount of remaining tooth structure present to provide restorative treatment. The fracture of the sample below the embedded resin was considered unfavourable as retreatment would be difficult.[1]

Results of this study showed that there was no significant effect of autoclave sterilization on fracture resistance of biologic post prepared from sterilized extracted teeth and direct autoclave sterilization of pre-fabricated biologic post. Results of this study correlates with the results of in-vitro Studies , which have shown that autoclaving of teeth may cause slight reduction in dentin micro-hardness, may not alter the physical properties that compromises the strength and has no effect on bond strength and dentin permeability.[11,12]

The results showed that except for one sample all the other sample (39) showed favorable fractures. There exist a definite correlation between post material and fracture of root. The post material should have same modulus of elasticity as the root dentin to distribute the forces evenly along the length of the post and the root. The biologic post with modulus of elasticity equal to dentin increases the likelihood failure of post core root interface instead of root fractures.[7, 8] Future studies can be done to evaluate other factors that affect the fracture resistance of endodontically treated tooth like post diameter, length, design, amount of remaining dentin of tooth, cement, method of cementation, core material and crown design in conjunction with biological post. Recent advances in precision milling technologies (CAD-CAM), extracted teeth can be milled into multiple biological posts. Further investigations are required to establish comparisons and agreements with this advanced technology.

CONCLUSION

With in the limitations of the study it is concluded that:

- Autoclaving does not significantly influence the fracture resistance of biologic posts in conjunction with composite core build up,
- The mode of failure was predominantly favorable in all groups.

References

1. Padmanabhan P. A comparative evaluation of the fracture resistance of three different pre-fabricated posts in endodontically treated teeth: An *in vitro* study. *J Conserv Dent*. 2010 ; 13(3): 124–28.
2. Corrêa-faria P, Pinto de Alcântara, Caldas-Diniz, Maria Botelho, Aguiar Tavano "Biological Restoration": Root Canal and Coronal Reconstruction. *J Esthet Restor Dent* 2010; 22:168–178.
3. Tavano KT, Botelho AM, Motta TP, Paes TM. Biological restoration: total crown anterior. Dent Traumatol 2009; 25:535–40.
4. Kanika Gupta Verma, Pradhuman Verma, Tanya Goyal. Recreation with biological restoration: A root canal reconstruction. *Journal of Health Specialties* 2014; 2 (1):31-33.
5. Attam K, Talwar S, Yadav S, Miglani S. Comparative analysis of the effect of autoclaving and 10% formalin storage on extracted teeth: A microleakage evaluation. *J Conserv Dent.* 2009 ; 12(1): 26–30.
6. Kumar M, Sequeira P S, Peter S, Bhat G K. Sterilisation of extracted human teeth for educational use.Indian *J Med Microbiol* 2005;23:256-258.

7. Sperandio M, Souza J B, Oliveira DT.Effect of Gamma Radiation on Dentin Bond Strength and Morphology *Braz Dent J* 2001; 12(3): 205-208.

8. Sidoli GE, King PA. An *in vitro* evaluation of a carbon fiber based postand core system. *J Prosthet Dent* 1997; 78:5-9.

9. Wadhwani K, Hasija M, Meena B, Wadhwa D, Yadav R. Biological restorations: Option of reincarnation for severely mutilated teeth. Euro J Gen Dent 2013: 2 (1): 62-6.

10. Mandroli P S. Biologic restoration of primary anterior teeth: A case report. *J Indian Soc Pedo Prev Dent* 2003; 21 (3): 95 – 97.

11. Kaizer OB, Bonfante G, Pereira Filho LD, *et al*. Utilization of biological posts to reconstruct weakened roots. Rev Gaucha Odontol 2008;56:7–13

12. Batista A, Lopes CG. Performed dentin post reinforcing teeth with immature apexes. Rev Bras Prot Clin Lab1999;3:199–21

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