Original Research

The Effect of Storage Environment on Dimensional Changes of Acrylic Resin Post Patterns

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Abstract

Introduction: The purpose of this study was to compare dimensional changes of two types of auto polymerizing acrylic resin patterns (APARPs) in three different storing environments. **Methods:** 60 acrylic post and core patterns were made of two types of Duralay acrylic resins (Aria dent, Iran and Reliance, Dental Mfg. Co, USA) using a canine model. Then coronal, apical diameter and coronoapical length of patterns were measured. Afterwards, they were divided into two categories of 30 for each type of Duralay acrylic resin type. Each category was divided into three groups of ten randomly to immerse in three storage environments (Deconex®53plus Borer ChemieAG, Switzerland), Unident ® Impre(USF Healthcare S.A, Sweitzerland) and water. After one hour, three mentioned values were measured again. Data were analyzed by SPSS20 using t-test, paired t-test and ANOVA. **Results:** Results showed that there were no statistically difference (p value> 0.05) about all dimensions of auto polymerizing acrylic post and core patterns except apical diameter and coronoapical length of Dental Mfg. Co, USA in Deconex®53 plus. **Conclusion:** The best environment to store Duralay APARPs with minimal changes was water and for disinfection, Deconex®53plus and Unident ® Imprecan showed acceptable properties with both of Duralay types.

Keywords: acrylic resin; dimension; dental disinfectants; post and core technique.

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Introduction

Oral rehabilitation plays an important role in masticatory function and facial esthetics. Reconstruction of impaired tooth structure as a part of oral rehabilitation is one of the basic treatment plans, especially after root canal therapy of severely damaged tooth, in modern dentistry. Post and core is a procedure to rebuild a tooth in order to provide proper support for a crown, regain retention and function. Misfit of posts and cores can affect thickness of cement layer and it may emerge problems such as vertical root fracture, marginal discrepancy, and consequently caries and periodontal diseases which result in treatment failure (1-4).

Polymers have been used in dentistry for many purposes ranging from dentures to veneers (1). Auto-polymerizing acrylic resins are one of the polymers which can be used in fabricating post and core patterns ,inlay patterns, bite registration and soldering (5). These materials offer strength, rigidity and provide easy manipulation with rotary instruments with no fear of distortion(6) but like other resins, they have shrinkage because of the polymerization procedure and this might have an adverse impact on retention and resistance of final posts and cores (7, 8).

Dental prosthesis are exposed to oral microbial flora such as viruses, bacteria, and fungi which can make cross infection and put the dental personnel at risk of acquiring infections while working with them (9, 10). Consequently, acrylic post and core patterns should be disinfected like every other materials used in a dental office before sending to the laboratory. Several studies have evaluated disinfection solutions and storage environments and their effect on dental materials like changing the color, hardness, roughness, dimensional stability, and flexural properties which may have an adverse influence on the clinical outcome (11-13).

Disinfection is an inevitable procedure so, determining the best disinfection for storing APARPs without any dimensional changes is very important. Hence, this study was aimed to compare the effect of three types of storage environments on the dimensional stability of post and core patterns**.**

Materials and Methods

This in-vitro experimental study was conducted on two type of Duralay auto-polymerizing acrylic resins (Aria dent, Iran and Reliance, Dental Mfg. Co, USA)) to make post and core patterns. Based on a result of a pilot study, 30 pieces were determined for each group (N=60).

To fabricate the acrylic specimens, a two-piece metallic cubic mold with internal pattern was constructed to simulate post and core pattern for a mandibular canine, the core was 8mm in length and 4.5 mm in width, the post was 12.5 mm in length, 1.5 mm in apical and 2.7mm in coronal dimension (Fig. 1). Next the polymer and monomer were manipulated in a ratio of 1:1 according to the manufacturer's instructions and poured into the lubricated mold .Then metallic mold were placed on a vibrator at room temperature to reduce the risk of bubble formation on the acrylic pattern. Acrylic resin setting was accomplished after 10 minutes which was recommended by the manufacturers. Afterwards, the patterns were gently removed from the mold. Corono-apical length (CAL), Coronal (CD) and apical diameters (AD) were measured immediately by a digital caliper with a precision about 1 mm (Mitutoyo, Japan: 0.01 mm). The distance from apical point to coronal margin was considered as CAL; AD was defined as the mesiodistal distance from 1.5 mm above the apical point and CD was defined as the mesiodistal distance from 1.5 mm beyond the coronal margin of APARPs.

The fabricated APARPs were stored into following storage environments: deconex®53plus (Borer ChemieAG,Switzerland), Unident ® Impre (USF Healthcare S.A,Switzerland) and water in 25°. Based on a computer-generated random sequence using http://random.org, a site of creating random numbers, each group contained 10 pieces of acrylic post and core patterns which were tested in three mentioned storage environments. The CAL, AD and CD of the acrylic post and core patterns were measured after one hour.

After one hour, mentioned measurements were compared with the base measurements and analyzed by Paired T-test and ANOVA using SPSS software version 17 at significant level of 0.05.

Results

Table-1 represents the means and standard deviations of measured CAL, AD and CD in three different environments after one hour. Datasets were parametric based on Kolmogrove –Smirnov test with p value= 0.083. To determine the difference in each sample before and after disinfection protocol, paired t - test was used which is shown in table 1. The data showed the post and core patterns by Aria Dent, Iran acrylic resin type, which were stored in Unident ® Impre, contracted 0.015, 0.07 and 0.013 mm in CD, AD and CAL, respectively while post and core patterns by Dental Mfg Co, USA in same environment, contracted 0.052, 0.08 mm in CD and CAL and dilated 0.048 mm in AD.

Also data showed that the post and core patterns by Aria Dent, Iran , which were stored inDeconex®53 plus, contracted 0.049,0.028 mm in CD and CAL and dilated 0.035mm in AD while post and core patterns by

Dental Mfg Co, USA acrylic resin type in same environment, dilated 0.041,0.57 mm in CD and AD and contracted 0.178 mm in CAL.

The post and core patterns by Aria Dent, Iran acrylic resin type , which were stored in water, dilated 0.04 mm in AD without changing in CD and CAL while post and core patterns by Dental Mfg Co, USA in water, contracted 0.037,0.036 mm in AD and CAL and dilated 0.024 mm in CD.

Results showed that coronoapical length, coronal and apical dimensions of post and cores had no significant difference (p value> 0.05) based on resins and disinfection environment type with the exception of following points: significant dimensional change was seen in apical diameter and coronoapical length with Dental Mfg Co, USA acrylic resin which were disinfected by Deconex®53 plus in comparison with pre disinfection scores(Paired T test :p =0.023). Differences between groups based on ANOVA test are presented in table 2 and 3.This test revealed that there is no statically differences between disinfection environments.

Table 1. Dimensional changes (mm) and P values of paired T-test of acrylic posts and cores patterns in different environments

Type of acrylic resins / Environments		Aria dent, Iran		Dental Mfg Co, USA	
		Mean± SD	**p-value***	**Mean± SD**	**p-value***
Unident ®	CD	0.015±0.030	0.209	0.052±0.141	0.274
	AD	0.070± 0.139	0.145	-0.048± .099	0.155
	CAL	0.013± 0.042	0.349	0.083± 0.457	0.593
Deconex ®	CD	0.049± 0.088	1.013	-0.041± 0.141	0.379
	AD	-0.035± 0.072	0.149	-0.57± 0.066	0.023
	CAL	0.028± 0.181	0.637	0.178± 0.348	0.023
Water	CD	0.000 ± 0.082	1.000	-0.024± 0.089	0.416
	AD	-0.040± 0.193	0.532	0.037± 0.171	0.511
	CAL	0.000± 0.293	1.000	0.036± 0.308	0.721

CD: coronal diameter, AD=Apical diameter, CA L=Coronoapical length

*= paired t-test

Table2. ANOVA results for effect of environment on dimensional changes of Aria dent, Iran pattern resin

environments		**P value**
Unident ®	Deconex ®	0.319
	Water	0.172
Deconex ®	Water	0.952

Table3. ANOVA results for effect of environment on dimensional changes of Dental Mfg Co, Inlay pattern resin, USA

environments		p value
Unident ®	Deconex ®	0.231
	Water	0.118
Deconex ®	Water	0.692

Discussion

Casted post and cores often required to provide retention and resistance form of complete crowns in non-vital teeth. It has been shown that the insertion of casting post and core can create vertical root fracture due to the wedging effect. Therefore, precise fabrication of acrylic post and core by stable dimensions during investing is essential which can significantly reduce further vertical fractures (7,14). Auto polymerizing resins have been used for direct post and core patterns fabrication. They have Several advantages but high polymerization shrinkage is a big disadvantage (15).

As the results show; the AD, CD and CAL of both of Duralay APARPs decreased in Unident ® Impre, Deconex®53 plus and water conditions but in some dimensions the specimens showed expansion .There were no significant difference in both contraction and expansion but with the exception about AD and CAL changes of Dental Mfg Co, USA acrylic resins in Deconex®53 plus solution, which were significantly expanded. Minimum and maximum changes occurred in water and Unident ® Impre, respectively .In comparison between AD, CD and CAL, the coronoapical length represented maximum contraction. Hence, the water prepares the best condition for storing Duralay APARPs. Mahmoud Sabouhi et al evaluated the effect of time and storage environment on dimensional changes of acrylic resin post patterns. They prepared acrylic post and core patterns for first premolar then the samples were divided into 3 groups based on storing environments: water, NaOCl 5% and air and dimensional changes in coronoapical length, coronal and apical diameter of acrylic patterns were measured in seven consecutive times (immediately after polymerization, 1, 2, 4, 8, 24, 48 hours later). They reported that it is better not to use NaOCl for disinfecting and the water obtains the best condition for storing Duralay acrylic resins which is in line with this study findings despite some differences (16).

Previous studies showed that the acrylic resins had a tendency to absorb water, thus expansion can compensate for a part of polymerization shrinkage. This can explain the least amount of dimensional changes observed in acrylic resin which were stored in water which is in accordance with this study results (17-19).

According to the report of Ghanbarzadeh et al (20), dimensional changes of Duralay post and core patterns were minimized while they were stored in wet medium at 25°C. This was in accordance with other investigations that used Duralay as the study material (5, 21)

Wong et al (17), reported that tendency to absorb water in acrylic resins can exhibit shrinkage during setting. Expansion following water absorption can compensate for a part or all of the polymerization shrinkage or even expansion can occur.

Mahshid M. et al (13) evaluated the effects of time elapse, disinfection solutions and preservation places on dimensions of Duralay acrylic pattern. In the mentioned study, 36 duralay patterns were categorized in to 3 groups of glutaraldehyde, sodium hypochlorite and control. Each group of 12 specimens was divided in the two groups of preservation places (wet and dry). They claimed that in air Condition, the contraction was obvious in the length and diameter size of acrylic Duralay and expansion were observed in NaOCl environment after 24 hours. It is obvious that as time passes the acrylic resins absorb more water and expand more and more. based on the results, significant differences were not shown between wet or dry preservation places. Mosharraf R. et al (22). Reported that if time laps for casting is more than one hour ,it is better to store acrylic model in water to minimize dimensional changes in air condition. In the present study, minimal changes were seen in water, which admitted these findings despite differences between these studies.

Conclusion

Within the limitations of this study, all three types can be used. The best environment to store Duralay acrylic resin post and core patterns was water and then Deconex®53 plus and Unident ® Impreare the superior choice respectively due to their disinfection ability.

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