Braz Dent J (2010) 21(4): 301-304 ISSN 0103-6440

Dimensional Alterations and Solubility of New Endodontic Sealers

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This study evaluated the dimensional alterations and the solubility of two experimental endodontic sealers based on *Copaifera multijuga* oil-resin (Biosealer) and castor oil bean cement (Poliquil), maintained in different storage solutions. Twenty specimens (3 mm diameter and 2 mm height) of each sealer were assigned to 2 groups (n=10) according to the storage solution: simulated tissue fluid (STF) or distilled water (DW). The specimens were stored in these solutions during 90 days, being removed every 30 days for weighting. The solutions were renewed every 15 days. The results were subjected to statistical analysis by Dunn's and Mann-Whitney tests (α=0.05). The solubility of Poliquil was higher in STF (38.4 ± 36.0) than in DW (28.4 ± 15.0), while Biosealer showed higher solubility in DW (34.61 ± 6.0) than in STF (18.59 ± 8.0). The storage solution influenced the behavior of sealers in relation to the weight variation (p=0.0001). Poliquil presented higher variation of weight independent of the solution (p=0.239). Biosealer also presented higher variation of weight regardless of the solution (p=0.0001). The solubility of Biosealer was different from that of Poliquil, but both sealers showed low solubility in STF. Under the tested conditions, neither of the materials were according to the ADA'S specification.

Key Words: endodontic sealers, root canal filling, endodontic.

INTRODUCTION

The dimensional stability of an endodontic sealer is important to provide the hermetic seal of root canal system to avoid the bacterial proliferation and increase the success of the endodontic treatment (1-3).

Phytotherapics have shown satisfactory results in several health fields, sometimes substituting the allopathic drugs. In Dentistry, phytotherapy research applied to endodontics has been explored to find less aggressive and biocompatible products with accessible cost (4).

Recently, a material based on a polymer derived from the castor oil plant (*Ricinus communis*) was introduced to Endodontics (4,5). The castor bean polyurethane cement (Poliquil; Poliquil Araraquara Polimeros Químicos Ltda., Araraquara, SP, Brazil) is composed of 81% to 96% triglyceride of ricinoleic acid, and is considered a natural polyol containing 3 hydroxyl radicals. This material has been reported to have antibacterial properties, is compatible with living connective tissues, has the potential to facilitate tissue healing, shows good mechanical properties, and is available at low cost (4). It has been successfully used as a retrograde filling material in apical surgeries, and as a sealer for root canal fillings (5,6).

The *Copaifera multijuga* oil-resin has been shown to have antiinflammatory, gastric protection,

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analgesic, wound healing (7,8), anti-nociceptive (9), and antimicrobial (10,11) properties. The possibility of a setting reaction between the alkaline constituents of calcium hydroxide and zinc oxide and the *Copaifera multijuga* oil-resin stimulated the search for biotechnological advances, aiming to obtain a new product based on the application of phytotherapy in endodontics. A new sealer (Biosealer, São Paulo, SP, Brazil) has been developed with a powder and a liquid component that are mixed to obtain the final product (12). The powder is composed of zinc oxide, calcium hydroxide, bismuth subcarbonate, natural resin (rosin) and borax, and the liquid is purified *Copaifera multijuga* oil-resin (12).

However, it is important to evaluate the characteristics of this sealer as any new dental product must be tested before being cleared for clinical use (8). According to Garrido et al. (12), Biosealer stimulates the repair and wound healing, does not promote tissue irritation, and presents antibacterial and antiinflammatory activity. In addition, it fulfils the chemical and physics requirements of the American Dental Association (ADA), as for satisfactory setting time, solubility, dimensional stability, flowing and radiopacity. This sealer also costs 3-fold less than Endofill (Dentsply Ind. e Com. Ltda., Petrópolis, RJ, Brazil), 4-fold less than Sealer 26 (Dentsply Ind. e Com. Ltda.), and 6-fold less AH Plus (Dentsply De Trey GmbH, Konstanz, Germany) promoting a wide use in clinical practice (12).

The aim of this study was to evaluate the dimensional stability and solubility of two experimental root canal sealers based on *Copaifera multijuga* oil-resin (Biosealer) and castor oil bean (Poliquil) after storage in distilled water (DW) or simulated tissue fluid (STF).

MATERIAL AND METHODS

Biosealer was prepared at a ratio of 0.43 g of powder and 0.2 mL of liquid according to Garrido et al. (12) and Poliquil was prepared using a powder-to-liquid mixing ratio according to the manufacturer's specifications.

Twenty specimens of each material were performed in matrix of Aquasil Ultra (Dentsply, Ind. e Com. Ltda.) with 3 mm of diameter and 2 mm of depth. The specimens were divided in 2 groups containing 10 specimens in each group according to the storage medium (DW or STF). The specimens were kept at conditions of 95% humidity and 37°C for 15 days. After the setting time, the surfaces of the specimens were polished with 600-grit sandpapers and then removed from the matrix and the initial weighting was performed in a digital balance (Eletronic Balance Bioprecisa; FA 2104 N, Shanghai, China).

The specimens were immersed again in 2 mL of DW or in 2 mL of STF (prepared by the Laboratory of Biochemistry of the São José dos Campos Dental School, São Paulo Sate University, Brazil) based on bloody plasma of rabbit diluted in sterile water, in the proportion 1:5, supplemented with glucose (85 mg%).

The specimens were kept in clean sterile glass flasks for 90 days. Every 30 days the specimens were removed of the storage medium, the excess of the liquid was dried with an absorbent tissue, and they were reweighed with the same digital balance.

The values of dimensional alterations in percentile were calculated based on the rules of ADA (13), using the following equation:

$$\frac{P_y - P_i}{P_i} \times 100$$

P_i - initial weight of the specimen; P_y - weight of the specimen each 30 days.

The solubility data were analyzed statistically by Tukey's and Kruskal-Wallis tests at 5% significance level.

RESULTS

After 30, 60 and 90 days of immersion in the storage solutions, the percentage values of final weight were compared to the initial weight values (Table 1). After 90 days in DW, Biosealer increased the weight by

Table 1. Percent weight variation of Biosealer and Poliquil after 30, 60 and 90 days in the different storage medium.

Endodontic sealers	Storage medium	Period		
		30 days	60 days	90 days
Biosealer	DW	26.50%	35.03%	34.61%
	STF	20.24%	24.00%	18.59%
Poliquil	DW	32.70%	43.50%	28.40%
	STF	35.00%	48.80%	38.40%

34.6% compared to initial weight. In contrast, weight increased by 18.6% after the same immersion period in STF, showing difference statistically significant between the storage medium (p=0.000).

Poliquil presented greater weight alteration in STF compared to DW after 90 days of storage (p=0.239). Biosealer presented significantly lesser weight variation than Poliquil after 90 days in STF (p=0.000) (Table 1 and Fig. 1).

DISCUSSION

Dimensional alterations might occur in endodontic sealers as a contraction of their volume, which can create empty spaces between dentin and filling promoting a possible bacterial contamination in that area. In contrast, the high expansion of volume can cause some inconveniences as the adhesion fails between the endodontic sealer and dentin (14,15). According to the ADA, solubility and disintegration of an endodontic sealer should not exceed 3% of the initial volume (12,16,17).

In the present study, the solubility of an endodontic sealer was evaluated by weight variation of specimens considering that the weight variation is higher as much as the expansion that the endodontic sealer suffers in the storage medium. Thus, after 90 days, the of Biosealer specimens increased by 35% and 18.6% in DW and STF, respectively, which is above the ADA'S recommendation. Poliquil also showed a volume increase by 28.4% and 38.4% in DW and STF, respectively. According some studies, the most of endodontic sealers present an initial expansion and disintegration with the time (16-19).

In contrast, Garrido et al. (12) investigated the chemical and physical properties of Biosealer and verified that this sealer lost its weight by 0.96% compared to the initial weight. However, the authors reported that Biosealer presented satisfactory results for all chemical physical tests, being considered as a good endodontic sealer.

In the present study, Biosealer showed expansion values in both storage media, probably due to the presence of rosin (natural resin) in its formulation (22%). The presence of rosin in a sealer plays an important role in its expansion (12).

In the present study, Poliquil presented high expansion values, which can be attributed to the hygroscopic property due to calcium carbonate and zinc oxide in its formulation (20). Both phytotherapic endodontic sealers showed a good potential as a new option for filling of root canal procedures. However, Biosealer and Poliquil should be further investigated before its use in clinical situations can be recommended.

The solubility of Biosealer was different from that of Poliquil, but both sealers showed low solubility in STF. Under the tested conditions, neither of the materials were according to the ADA'S specification.

RESUMO

O presente estudo avaliou a alteração dimensional e solubilidade de 2 cimentos experimentais (à base de resina do óleo de Copaíba - Biosealer e cimento do polímero da mamona - Poliquil), mantidos em diferentes meios de armazenamento. Foram confeccionados 20 espécimes de cada cimento com 3 mm de diâmetro e 2 mm de altura os quais foram divididos em 2 grupos (n=10) de acordo

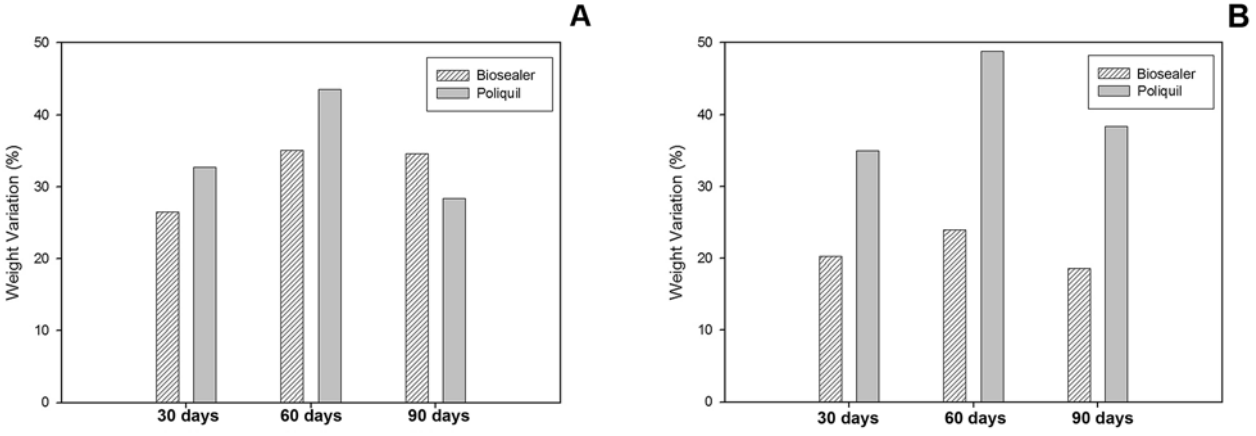

Figure 1. Comparison of weight variation of the sealers after storage in distilled water (A) and simulated tissue fluid (B).

com o meio de armazenamento (fluido tissular simulado ou água destilada). Os espécimes foram atidos nas soluções durante 90 dias, sendo removidos a cada 30 dias para pesagem das amostras, no entanto as soluções foram trocadas a cada 15 dias. Os resultados foram submetidos aos testes de Dunn (5%) e Mann-Whitney. Os meios de armazenamento causaram influência no comportamento dos cimentos em relação ao peso (p=0,0001). Poliquil apresentou alta variação de peso independente da solução (p=0,239). Biosealer também apresentou alta variação de peso independente da solução (p=0,0001). A solubilidade do Biosealer foi diferente do Poliquil, entretanto, ambos cimentos mostraram baixa solubilidade no fluido tissular simulado. Nas condições do experimento, nenhum cimento está de acordo com a especificação da ADA.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge Prof. Manoel Damião de Sousa-Neto for providing the *Copaifera multijuga* oil-resin (Biosealer) used in this study.

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Accepted September 9, 2010