Short Communication

Degradation of Tissue Conditioners in Complete Dentures: An In Situ Study

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This in situ study evaluated the Shore A hardness and phthalate concentration of 3 tissue conditioners (Coe-Comfort, Dura Conditioner, Softone) inserted into grooves on 9 maxillary dentures. Data were collected at baseline and after 3, 7, and 14 days of denture use. All materials showed a decrease in phthalate concentration and an increase in hardness over time, but the largest changes occurred during the first 3 days; 59% to 74% of the hardness variability was explained by the phthalate concentration. Overall, Coe-Comfort was softer and had less alteration in its phthalate concentration than Dura Conditioner and Softone up to day 7. *Int J Prosthodont 2008;21:486–488.*

Tissue conditioners are made up of methacrylate-based resin and plasticizers. Plasticizers reduce the polymer transitional glass temperature, resulting in greater mobility of the polymeric chains and material flexibility.[1] Water sorption[2] and lixiviation of ethanol[3] and phthalate[4,5] may assist in the degradation of tissue conditioners during clinical service. Although the chemical and physical degradation of tissue conditioners may be characterized by plasticizer loss and an increase in hardness, respectively, the longitudinal relationship of these 2 variables has not been quantified in the oral environment. Thus, this study used an in situ model to evaluate the degradation of 3 tissue conditioners over 14 days and to assess the relationship between hardness and plasticizer content.

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Materials and Methods

The research protocol was approved by the institutional review board, and all participants signed an informed consent form. The sample was composed of 9 healthy edentulous patients (mean age: 63.4 ± 14.6 y) who had attended the university dental clinics for the replacement of existing dentures.

Table 1 lists the specifications of the 3 tissue conditioners tested. Three grooves (5 × 15 × 2 mm) were made in the internal surface of each maxillary denture and were filled with the tissue conditioners in a random order. At baseline, 1 specimen of each material per subject was retrieved for analysis; on days 3, 7, and 14, portions (5 × 5 × 2 mm) of each sample were removed from the dentures. The empty spaces were filled with self-cured acrylic resin, and the denture was used by the patient until the following session. The retrieved specimens were cut with a circular punch blade (4 mm in diameter) before measurements were made. Hardness was recorded using a Shore A hardness tester (Teclok, Woltest, Metaltest Indústria e Comércio) according to ASTM standard D2240/75.

Table 1 Specifications of the Tissue Conditioners Tested

Trade name/manufacturer	Batch no.	Chemical composition
Coe-Comfort, GC America	Powder: 041 1111; liquid: 041 0201	Powder: Poly (ethyl methacrylate), zinc undecylenate, pigments; liquid: benzyl benzoate, cotton seed oil, alcohol, dibutyl phthalate, methyl salicylate, pepper oil
Dura Conditioner, Reliance Dental Manufacturing	Powder: 040804; liquid: 051304	Powder: Copolymer of methyl methacrylate; liquid: monomer of methyl methacrylate, dibutyl phthalate
Softone, Harry J. Bosworth	Powder and liquid: 041-048	Powder: Poly (ethyl methacrylate), fillers; liquid: allyl phthalate, ethanol

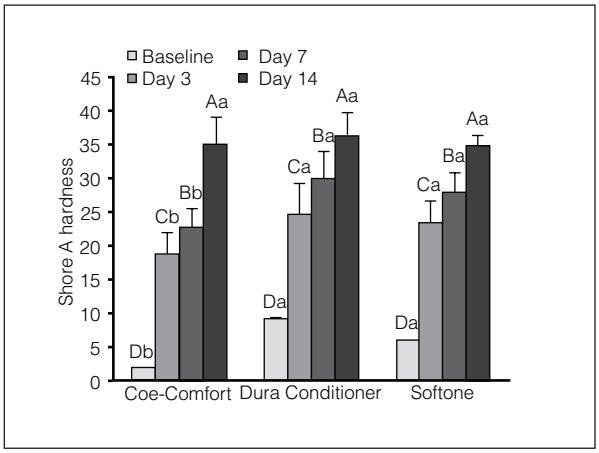


Fig 1 Shore A hardness of the tested tissue conditioners at baseline and on days 3, 7, and 14. Means followed by different uppercase letters (comparison among time intervals) and lowercase letters (comparison among materials) are statistically different at the 5% significance level.

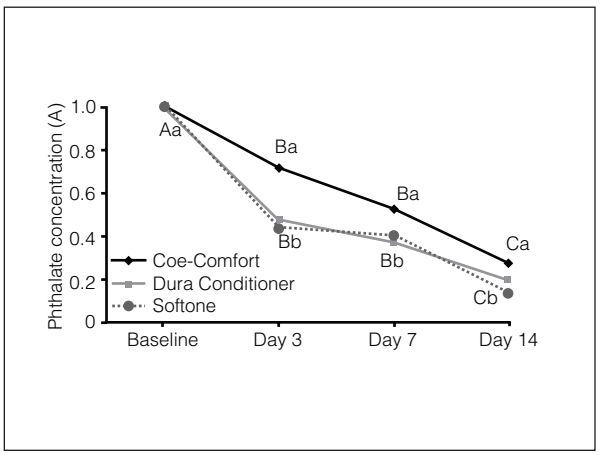


Fig 2 Normalized phthalate concentration in the tested tissue conditioners at baseline and on days 3, 7, and 14. Means followed by different uppercase letters (comparison among time intervals) and lowercase letters (comparison among materials) are statistically different at the 5% significance level.

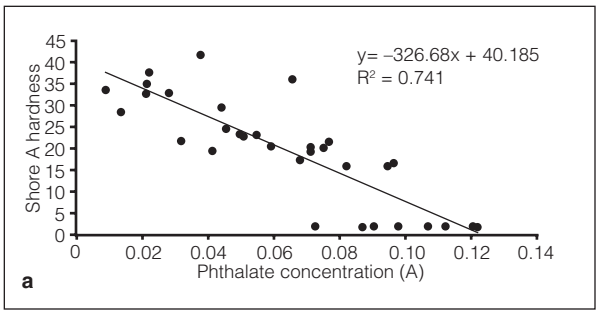
The phthalate quantification was performed by Fourier-transformed, infrared-attenuated total reflectance (FTIR-ATR) using a spectrometer (Spectrum One EVA, Perkin-Elmer) equipped with a flat zinc selenide crystal. Four scans were performed at a frequency of 4,000-650 cm^{-1} with resolution of 4 cm^{-1}. In a standard phthalate spectrum (Integrated Spectral Database System of Organic Compounds, National Institute of Advanced Industrial Science and Technology) the 1,720 cm^{-1} peak corresponds to the vibration of carbonyl and was chosen to compute the relative phthalate quantity in each specimen. The spectrum of each specimen scan was transformed to Absorbance (A; arbitrary units), and the maximum peak at 1,720 cm^{-1} was isolated. Original data of each subject were normalized in relation to the maximum value at baseline.

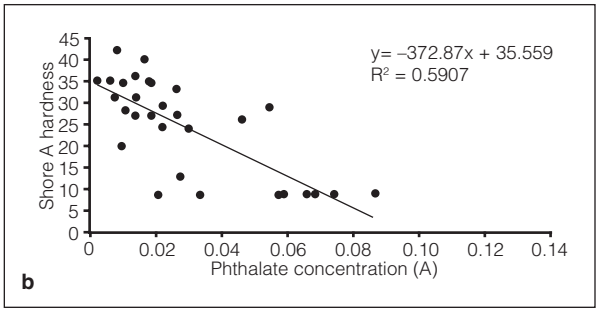
Data were analyzed using analysis of variance for repeated measures, followed by the Tukey test and linear simple regression, at a .05 level of significance.

Results

For hardness, a significant interaction was found between tissue conditioner and time ($P = .006$). Coe-Comfort was softer than Dura Conditioner and Softone at all time points except day 14 (Fig 1). For phthalate concentration, a significant effect was found for tissue conditioner ($P = .006$) and time ($P < .001$). Coe-Comfort had a lower relative loss of plasticizer versus the other materials (Fig 2).

All linear regression models of hardness as a function of phthalate concentration showed a significant inverse relationship ($P < .001$) (Fig 3).





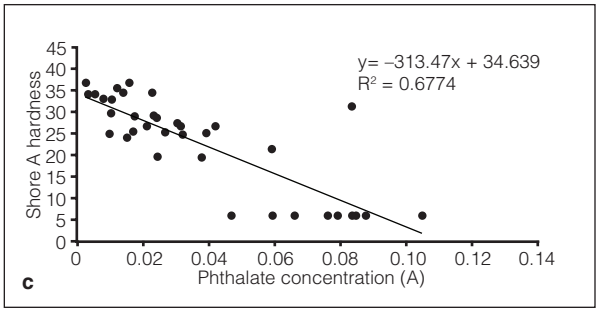


Fig 3 Graphs of the simple linear regression of Shore A hardness as a function of phthalate concentration for (**a**) Coe-Comfort, (**b**) Dura Conditioner, and (**c**) Softone.

Discussion

All tissue conditioners showed a reduction of phthalate concentration and an increase in hardness over 14 days, but the degradation patterns were material-specific. Most of the variations in hardness were explained by phthalate concentration, which was directly quantified by FTIR-ATR spectroscopy with no need for dilution or other sample preparation.

The largest changes in phthalate concentration and hardness occurred in the first 3 days. Although Coe-Comfort showed a greater increase in hardness from baseline to day 3, it was significantly softer than the other materials and had the greatest retention of plasticizer after 7 days. From day 3 to day 7 there was no significant loss of phthalate in any material, but hardness increased slightly. Plasticizer release facilitates the increase of water sorption, leading to hydrolytic degradation and polymer solubility[2]; this explains why physical alteration followed chemical degradation. After 14 days all materials showed similar hardness, a large loss of phthalate, and visible surface deterioration. Therefore, the findings of this study support the clinical use of the tested tissue conditioners for up to 1 week, but the materials should be replaced after 3 days if original characteristics are needed.

References

1. Graham BS, Jones DW, Sutow EJ. An in vivo and in vitro study of the loss of plasticizer from soft polymer-gel materials. J Dent Res 1991;70:870–873.
2. Kalachandra S, Turner DT. Water sorption of plasticized denture acrylic lining materials. Dent Mater 1989;5:161–164.
3. Wilson J. In vitro loss of alcohol from tissue conditioners. Int J Prosthodont 1992;5:17–21.
4. Aloul RK, Shen C. The influence of plasticizer loss on the viscoelasticity of temporary soft liners. J Prosthodont 2002;11:254–262.
5. Munksgaard EC. Leaching of plasticizers from temporary denture soft lining materials. Eur J Oral Sci 2004;112:101–104.