Journal of Dental Sciences (2015) 10, 275–281

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.e-jds.com

ORIGINAL ARTICLE

The effect of pouring time on the dimensional stability of casts made from conventional and extended-pour irreversible hydrocolloids by 3D modelling

Hasan Ö. Gümüş [a], Mehmet Dinçel [a*], Süleyman K. Büyük [b], Halil İ. Kılınç [a], Mehmet S. Bilgin [c], M. Zortuk [a]

[a] *Department of Prosthodontics, Faculty of Dentistry, Erciyes University, Kayseri, Turkey*
[b] *Department of Orthodontics, Faculty of Dentistry, Erciyes University, Kayseri, Turkey*
[c] *Department of Prosthodontics, Faculty of Dentistry, Sifa University, İzmir, Turkey*

Received 2 April 2013; Final revision received 23 February 2014
Available online 28 July 2014

KEYWORDS
irreversible hydrocolloids;
alginates;
dimensional stability;
extended-pour;
3D model scanning

Abstract *Background/purpose:* The aim of this study was to determine the accuracy of casts made from irreversible hydrocolloid impressions with immediate and delayed pouring.
Materials and methods: A master model was mounted on a modified articulator designed to standardize impression procedures. A total of 250 impressions were taken and grouped into 25 groups ($n = 10$) according to irreversible hydrocolloid material (CA37, Tropicalgin, ColorChange, Hydrogum 5, and Hydrocolor 5) and storage time (0 hours, 1 hour, 24 hours, 72 hours, and 120 hours). Impressions were stored at 23 ± 1°C and 100% relative humidity and poured with gypsum at the predetermined storage time. Casts were scanned with a three-dimensional (3D) model scanner. The digital models were measured and subtracted from the measurements obtained from the master model. The absolute values of dimensional differences were statistically analyzed using two-way analysis of variance (ANOVA) and *post hoc* Fisher LSD test ($P < 0.05$).
Results: Different irreversible hydrocolloids and pouring times showed significant differences ($P < 0.001$). In all irreversible hydrocolloids, no statistically significant differences were found with impressions poured after 0 hours, 1 hour, and 24 hours of storage ($P > 0.05$). However, after 72 hours and 120 hours of storage, Tropicalgin and CA37 irreversible hydrocolloid impressions were found to be significantly different ($P < 0.05$). Moreover, ColorChange, Hydrogum 5, and Hydrocolor 5 irreversible hydrocolloid impressions were not statistically different up to 120 hours ($P > 0.05$).

* Corresponding author. T.C. Erciyes Üniversitesi Diş Hekimliği Fakültesi ve Hastaneleri, Protetik Diş Tedavisi AD 38039, Melikgazi, Kayseri, Turkey.
E-mail address: mdincel1@yahoo.com (M. Dinçel).

http://dx.doi.org/10.1016/j.jds.2014.05.003

Conclusion: All of the conventional and extended-pour impression materials tested in this study can be poured up to 24 hours with accuracy, if impressions are correctly stored. Extended-pour impression materials (ColorChange, Hydrogum 5, and Hydrocolor 5) can be poured up to 120 hours, if stored correctly.

Introduction

Irreversible hydrocolloids are one of the most common impression materials used in the dental office. These water-based materials are inexpensive and can be easily manipulated by following the manufacturer's instructions[1,2] to create mouth guards, impressions for removable prostheses, preliminary impressions for complete dentures, and orthodontic and research models.[3,4]

The greatest disadvantage of an irreversible hydrocolloid is its low dimensional stability, which can be defined as the ability of a material to maintain accuracy across time.[5] Water absorption (imbibition) and water release (syneresis) that occurs over time may result in the production of inaccurate casts, and it is generally recommended that irreversible hydrocolloid impressions be poured immediately[3,6] or within 10—12 minutes of removal from the mouth[7,8] without wrapping in a damp paper towel.[6,8] This is because it is not possible to predict the amount of water that may be absorbed by the impression material. However, immediate pouring of an impression may not always be possible, especially if it must be shipped to a dental laboratory.

Ideally, an impression material should be dimensionally stable over time in order to allow the operator to pour an impression at his/her convenience. A number of alternative "extended-pour" irreversible hydrocolloids are available on the market that claim to maintain dimensional stability and accuracy with delayed pouring times of up to 4 days or 5 days, if the impressions are wrapped in a damp towel or sealed in a plastic bag.[4,6,9,10]

In recent years, different tests have been developed to analyze dimensional stability of materials.[11—21] However, many studies conducted in relation to the dimensional stability of irreversible hydrocolloids have limited relevance today, as many of the materials studied are no longer commercially available. Among recent studies, interest has also focused on the effects of disinfection materials and procedures on the dimensional stability of impression material.[13,18,19,22]

The aim of the present study was to investigate the dimensional stability of different irreversible hydrocolloid impressions at different storage times. Of the various irreversible hydrocolloids tested, three claim to maintain dimensional stability for up to 5 days. The study was conducted in a laboratory environment designed to simulate clinical practice and shipping under specified, standardized conditions. In order to reduce the number of variables, the impressions were not subjected to any disinfection, and irreversible hydrocolloid adhesives were not used.

The null hypothesis was that dimensional accuracy would not differ significantly among the three "extended-pour" irreversible hydrocolloid and two conventional irreversible hydrocolloid materials, regardless of cast pouring time.

Materials and methods

Five irreversible hydrocolloid impression materials from two different manufacturers and generally used for prosthetic purposes were selected for the study (Table 1). All procedures were carried out under the same conditions.

Standardization of impressions

A device resembling Wandrekar et al's[14] system was developed to reproduce clinical conditions and standardize impression procedures (Fig. 1).

Self-curing acrylic (PalapressVario, Heraeus Kulzer, Hanau, Germany) was poured into a rubber mold (ANA 4-G, Frasaco, Tettnang, Germany) to create a master model of a complete upper dental arch with 16 teeth. Specific reference points for cast measurements were identified on the cusps of the canines (13, 23) and on the mesiobuccal cusps of the first molars (16, 26) by attaching a metal cone at each reference point. In order to ensure accurate and reproducible positioning of trays during impression-taking, standardized tray placement was achieved by fabricating a light-cured polymethylmethacrylate seat (Durabase LC, Duradent, Polzano, Italy) that was affixed to the lower side of the articulator (Keystone Industries GmbH, Singen, Germany) to provide a firm fit for impression trays, and impressions were taken with the articulator's posterior stop-pin in contact with the opposite side of the articulator.

Table 1 Hydrocolloid impression materials used in the study.

Impression material	Supplier	Type
CA37	Cavex, Haarlem, The Netherlands	Conventional
Tropicalgin	Zhermack Spa, Badia Polesine, Italy	Conventional
ColorChange	Cavex, Haarlem, The Netherlands	Extended-pour
Hydrogum 5	Zhermack Spa, Badia Polesine, Italy	Extended-pour
Hydrocolor 5	Zhermack Spa, Badia Polesine, Italy	Extended-pour