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Reliability of a new test food to assess masticatory function

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ABSTRACT

Objective: This study assessed the reliability and validity of masticatory function assessment using a new test food, Optozeta.
Design: Thirty-five adults participated in the cross-sectional clinical part of the study; ten of them performed a retest. They performed two free-style masticatory tests consisting of five trials of 20 cycles each chewing three pieces of Optosil or Optozeta placed in a latex bag. Optozeta was created by mixing 50% Optosil with 50% of Zetalabor. Masticatory performance, masticatory laterality and chewing rate were assessed. Reliability and construct validity were assessed using the intraclass correlation coefficient (ICC) and Spearman correlations, respectively.
Results: Higher ICC values were observed for each aspect of masticatory function as assessed using Optozeta compared with Optosil. All the participants showed a lower median particle size value using Optozeta than Optosil. For each masticatory parameter, a high correlation was observed between using Optosil or Optozeta.
Conclusions: Optozeta seems to have good construct validity and appears to be more reliable than Optosil as a test food to assess masticatory function.

1. Introduction

Restoration or improvement of masticatory function is a major objective of prosthodontic treatment (Jokstad & Orstavik, 1998). Masticatory performance, a principal aspect of this function, can be determined by quantifying the degree of fragmentation of a test food after a fixed number of chewing cycles (Flores-Orozco, Rovira-Lastra, Willaert, Peraire, & Martinez-Gomis, 2016; Lujan-Climent et al., 2008; Van Der Bilt & Fontijn-Tekamp, 2004). Although natural foods have been used for this, dental silicone (Optosil®) is considered a more appropriate test food when assessing masticatory performance because it can be standardized, does not dissolve in water, and can be stored for 7 days without losing its mechanical properties (Albert, Buschang, & Throckmorton, 2003; Compagnon, Veyrune, Morenas, & Faulks, 1999; Edlund, 1980; Slagter, Olthoff, Bosnian, & Steen, 1992). However, subjects wearing complete dentures, removable partial dentures, or implant-supported overdentures have been reported to have bite forces of 55–120 N, 175 N, and 200 N, respectively, which differ significantly from the 500 N reported for dentate subjects (Fontijn-Tekamp, Slagter, van't Hof, Geertman, & Kalk, 1998; Lujan-Climent et al., 2008; Miyaura et al., 2000). Therefore, people with chewing difficulties may not comminute the Optosil pieces, which makes this artificial test food unsuitable (Slagter, Bosman, & Van der Bilt, 1993). Optocal, an alternative chewable material composed of condensation silicone, toothpaste, solid Vaseline®, dental plaster, alginate powder, and mint essence, has been described for assessing masticatory performance in this patient group (Pocztaruk, Frasca, Rivaldo, Fernandes, & Gavião, 2008; Slagter, Bosman, & Van der Bilt, 1993). However, the number of components and the diversity of origin make Optocal difficult to standardize. Although hardness and tensile strength have been reported for several synthetic test foods based on condensation silicone with different percentages of silicone oil, none of these alternative test foods has made a major impact in clinical studies (Compagnon, Veyrune, Morenas, & Faulks, 1999).

Another important aspect of oral function is masticatory laterality, or masticatory jaw movements, and this can also be assessed using pieces of the artificial test food Optosil placed either in a latex bag or used freely (Farias Gomes, Custodio, Moura Jufer, Del Bel Cury, & Rodrigues Garcia, 2010; Flores-Orozco and Tiznado-Orozco et al., 2016; Martinez-Gomis et al., 2009; Rovira-Lastra, Flores-Orozco, Ayuso-Montero, Peraire, & Martinez-Gomis, 2016; Rovira-Lastra, Flores-Orozco, Salsench, Peraire, & Martinez-Gomis, 2014). To assess masticatory function in a population with compromised mastication, the ideal test food would be less elongated at its breaking point than Optosil

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(Compagnon, Veyrune, Morenas, & Faulks, 1999; Slagter, Olthoff, Bosnian, & Steen, 1992). Zetalabor is a harder condensation silicone that seems to be easily fragmented into small pieces. A new test food is therefore proposed here called Optozeta, created by mixing 50% Optosil with 50% Zetalabor, as it could be useful for assessing masticatory function in subjects wearing dental prostheses or who have difficulties chewing. The ideal method to assess different aspects of masticatory function will simple, reliable and valid (Mokkink et al., 2010).

The main objective of this study was to compare the reliability of masticatory performance assessment using Optozeta or Optosil as the test food. We also aimed to assess the reliability of masticatory laterality and chewing rate measurements using Optozeta as a test food, and to assess the construct validity with regard to masticatory performance, masticatory laterality and chewing rate using Optozeta as a test food. A preliminary study was aimed to compare hardness and elongation at breaking point of Optozeta with those of Optosil over the first 7 days after preparation. The null hypothesis was that the reliability of masticatory performance assessment using Optozeta is no different from that using Optosil.

2. Materials and methods

This study consisted of 2 parts: an in vitro and preliminary study to assess the mechanical properties of Optozeta and a clinical study to validate the new test food as a means of assessing masticatory function (Fig. 1).

In the in vitro study, 33 specimens of Optosil (Optosil P Plus; Heraeus Kulzer, Hanau, Germany) and 33 specimens of Optozeta were prepared. Of these, 18 specimens per group were dumbbell-shaped (120 mm long, 30 mm wide, and 2 mm thick) and 15 specimens per group were shaped into tablets (20 mm diameter and 5 mm thick). These specimens were randomly assigned to groups A, B, and C, which were tested after 4 h, 3 days, and 7 days of processing, respectively. The putty and paste components of Optosil were mixed following the protocol described by Albert, Buschang, and Throckmorton, (2003). Briefly, one level scoop of the putty (15.5 g) was mashed vigorously with paste-hardener (3 cm long by 2 mm wide, 0.20 g in weight) for 30 s, before being placed on a metallic base and squashed with a metallic cover separated by stops measuring 5 mm. The resultant Optosil plates was allowed to set for 15 min and was then removed from the metallic base, and 15 tablets were obtained from it. The dumbbell-shaped Optosil specimens were prepared using the same protocol as for the Optosil tablets, but with six silicone sheets measuring 2 mm thick. Optozeta was formed following the same protocol described for Optosil, modified as follows: one researcher vigorously mashed the Optosil putty with the paste-hardener, while another researcher vigorously mashed one level scoop (17.25 g) of the Zetalabor putty component (Zhermack SPA, Rovigo, Italy) with paste-hardener (3 cm long by 2 mm wide, 0.20 g in weight), both for 10 s; then, one of the researchers combined the two silicone mixtures and vigorously mashed them for a further 20 s. Shore A hardness was measured at the three study time points (n = 5), using a durometer in accordance with ISO 868.2003. Tensile testing was conducted in accordance with ISO 37-1 and the crosshead speed was 500 mm/min. Elongation at breaking point were recorded for the two silicones at the three time points (n = 6) (Fig. 1).

In the cross-sectional clinical study, 35 adults (23 women and 12 men; age range: 19–77 years, mean age 37), were recruited from students and staff at the University of Barcelona Dental School (Catalonia, Spain) and from patients attending the Barcelona University Dental Hospital. Of the participants, 25 had natural dentition, 6 wore removable partial or complete dentures, and 4 wore implant-supported partial prostheses (Fig. 1). A test-retest was performed on 15 participants (11 women, mean age 34, 13 had natural dentition and 2 wore removable dentures), chosen by convenience, 1–2 weeks after the first test. The subjects were fully informed and signed an informed consent form approved by the Barcelona University Dental Hospital Ethics Committee (Code 2015/32). All the experiments were carried out in accordance with the principles of the Helsinki Declaration.

Each participant performed two different masticatory assays each consisting of five trials of 20 cycles each chewing 2 g of silicon. Optosil and Optozeta tablets (5 mm thick, 20 mm diameter) were produced as for the in vitro study, cut into quarters, and three of the quarter tablets

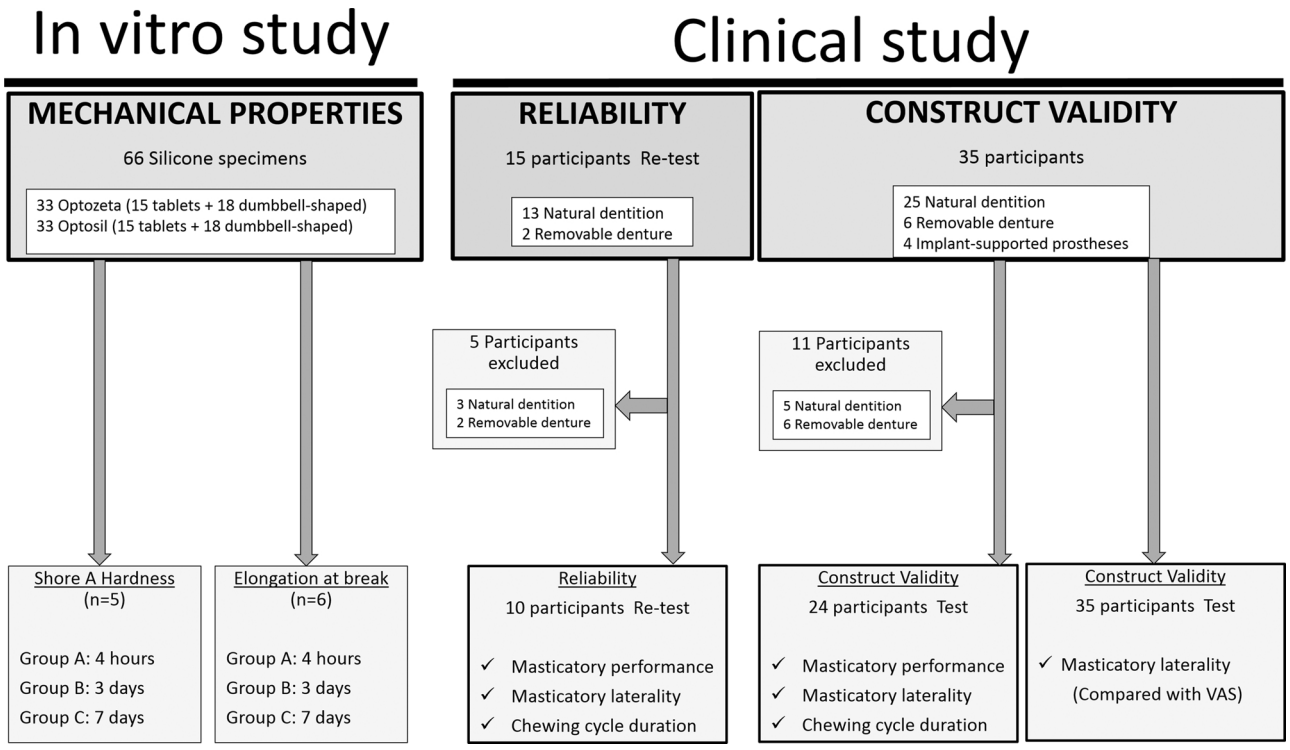

Fig. 1. Flowchart of the in vitro and clinical studies.