A COMPARATIVE STUDY OF SOLUBILITY BETWEEN RESIN CEMENT AND SELF-ADHESIVE RESIN CEMENT

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Abstract
Resin cements have been largely used for luting indirect restorations due to their bonding abilities to the tooth structures and the increase of the restorations stability; however their solubility can negatively affect the restoration durability. The aim of this in vitro study was to evaluate and to compare water solubility values of conventional resin cement with self-adhesive resin cement according to ISO 4049 specification.

Two commercial dental luting cement materials were selected: Conventional resin cement (Resicem™ /Shofu) and self-adhesive resin cement (Total Cem, Itena). Ten discs were prepared of each cement material. The discs were made according to the manufacturer’s instructions using a cylindrical teflon mold of 5 mm inner diameter and 2 mm thickness.

The discs were weighed on a precision weight scale to record their individual baseline weight (w1), measured by a digital caliper to record their volume (v), then immersed in 10mm distilled water at 37°C and 50rpm. After that, the specimens were desiccated then weighed (w2) at different interval periods (1, 14, 30 and 90 days). The solubility value was obtained based on the equation: Solubility = (w1-w2) / v. Collected data was statistically analyzed for significant differences by one-way ANOVA (p=0.05).

The mean solubility value (µg/mm3) obtained after 90 days was 3.86±0.36 for Resicem™ and 12.93 ±1.33 for Total Cem. Within the limitations of this in vitro study, the conventional resin cement showed the highest resistance to solubility compared to the self-adhesive resin cement.

Keywords: Resin cement – solubility – self-adhesive cement.

Résumé
Les ciments en résine ont été largement utilisés pour le scellement des restaurations indirectes en raison de leur capacité à se lier aux structures dentaires et à accroître la stabilité des restaurations; cependant, leur solubilité risque d’affecter négativement la durabilité des restaurations. Cette étude in vitro a pour but d’évaluer et de comparer le degré de solubilité, dans l’eau, d’un ciment résine conventionnel à celui d’un ciment résine auto-adhésif, en respectant les exigences de la norme ISO 4049.

Deux ciments de scellement ont été choisis: un ciment résine classique (Resicem™/Shofu) et un ciment résine auto-adhésif (Total Cem, Itena). Dix spécimens sous forme de disques ont été préparés à partir de chaque matériau. Les disques ont été réalisés conformément aux instructions du fabricant, en utilisant un moule cylindrique en teflon de 5mm de diamètre interne et de 2mm d’épaisseur. Le poids de départ (w1) et le volume (v) de chaque disque ont été enregistrés en utilisant une balance et un pied à coulisse digital, respectivement. Ils ont été ensuite immersés dans 10mm d’eau distillée à 37°C et 50rpm. Les spécimens ont été desséchés et pesés (w2) à différents intervalles (1, 14, 30 et 90 jours). Le degré de solubilité a été évalué en appliquant l’équation: solubilité = (w1-w2) / v. Les résultats ont été analysés à la recherche de différences statistiquement significatives par le test ANOVA (p = 0.05). Les valeurs moyennes de solubilité (µg/mm3) après 90 jours pour chaque ciment étaient 3.86 ±0.36 pour Resicem™ et 12.93 ±1.33 pour Total Cem. Dans les limites de cette étude, le ciment résine classique a montré une plus grande résistance à la solubilité par rapport au ciment résine auto-adhésif.

Introduction

Restorative dentistry is constantly undergoing changes, driven in part by new clinical applications of existing dental materials and the introduction of new materials [1]. Presently, various types of adhesive cement are used for permanent and temporary cementation of indirect restorations. These cements have different mechanical and biological characteristics [2].

Resin cements have been largely used for luting indirect restorations due to their bonding abilities to the tooth structure and their better mechanical characteristics compared to those of conventional luting agents [1]. However, many clinicians prefer to cement all-ceramic inlays and onlays with self-etching, dual-cure resin cements. These systems contain self-etching adhesive and dual-cure resin cement in the same formula; therefore, a separate bonding adhesive is not required. This significantly reduces the number of steps, leaving less room for operator error [2].

Dental cements’ performance is conditioned by their adequate resistance to dissolution in the oral environment, the strong bond through mechanical interlocking and adhesion, the high strength under tension, the good manipulation properties such as acceptable working and setting times and the biologic acceptability for the substrate [3]. Failures due to deteriorated mechanical properties may be explained by the influence of moisture from the oral environment on the luting cements, leading to degradation [4] and debonding of the restoration which causes microleakage and recurrent decay [5, 6]. Therefore, resistance to solubility is an important feature in assessing the clinical durability of luting cements [7]. Thus, this study was performed to compare the solubility feature of a conventional resin cement and a self-adhesive resin cement used in current clinical dentistry.

Materials and Methods

Two commercial dental luting cement materials were selected: Conventional resin cement (Resicem™ /Shofu) and self-adhesive resin cement (Total Cem, Itena®). Ten specimen discs were prepared for each cement material according to the manufacturer’s instructions using cylindrical teflon mold (5x2mm). The resin cements were placed in the mold and pressed by plastic matrix strips under hand pressure to extrude any excess material. Then, they were light-cured by halogen light (380 mw/cm²) for 40 seconds. The discs were weighed on a precision weight scale to record the original weigh (w1) and their volume was measured by digital caliper. After that, specimens were immersed in vials containing 10mm of distilled water; the vials were wrapped in aluminum foil to exclude light and placed in an incubator at 37°C and 50rpm. After immersion, specimens were desiccated in an oven at 100°C for 2 hours and weighed (w2) at different interval periods (1, 14, 30 and 90 days). The solubility values were calculated using the equation (ISO 4049:2000): S= w1-w2/v, where w1 is the specimen mass before water immersion (mg), w2 is the specimen mass after immersion and desiccation (mg), and v is the specimen volume before immersion (mm³). For each group, the mean for solubility was calculated.

Statistical Analysis

Statistical analysis for cement solubility values was performed using one-way ANOVA and Bonferonni’s test. The alpha error was set at 0.05.

Results

Table 1 summarizes the solubility means of resin cement and self-adhesive resin cements, respectively in μg/mm³. For each group, the mean for solubility was calculated.

Discussion

The method used for testing solubility in this study followed a modification of the section 7.12 of ISO 4049. The test requires that specimens are first placed in desiccators immediately after curing.
and removal from the mold. The section 7.12 was modified by placing specimens in a solution of distilled water immediately after preparation [9]. The aim was to ensure that the results of solubility are static because desiccation of specimens immediately after fabrication might also affect their solubility results due to damage.

The rate of dissolution can be influenced by the test conditions as well as the time of dissolution, the concentration of the solute in the dissolution medium, the pH of the medium, the specimen shape and thickness [10]. In our study, distilled water served as medium; in vitro tests are only static, so they do not simulate the pH and temperature changes of the oral cavity [11].

The study results showed that the self-adhesive resin cement exhibited the highest mean solubility value compared to the conventional resin cement as shown in table 1. This difference can be attributable to the hydrophilic nature and the matrixes composition of the self-adhesive resin cement [11, 12]. The resin cements are basically insoluble but may release small amounts of unpolymerized monomer constituents. The factors that influence solubility include the filler concentration, the nature of the filler particles and their mean size as well as the coupling agents [13].

Materials can exhibit different behaviors during their interaction with water (Vrochari et al. [16]). In fact, the hydrophilic constituents of the resin cements such as hydroxyethyl methacrylate (HEMA) or the resin molecules that contain hydrophilic moieties increase solubility [14, 15]. That may explain the higher solubility observed for Total Cem. It is difficult to correlate data for solubility with those of other studies, since the results will inevitably vary due to the use of different time periods and measurement units [17]. Moreover, comparisons are difficult due to differences in the reported specimen sizes. For small specimens, the time period for water equilibration is short; the materials that absorb more water take longer time to stabilize [14].

This study showed that solubility increased with the immersion time, similar results were reported by Yoshida et al. [8].

**Conclusion**

Within the limitations of the present study, it can be concluded that the self-adhesive resin cement (Total Cem) exhibited higher values of water solubility compared to the conventional resin cement. This was attributed to the hydrophilic nature of the Total Cem as well as to the filler characteristics. Conventional resin cement appeared to meet longevity requirements more than self-adhesive resin cement.

**References**