Effect of Original Water Content in Acrylic Resin on Processing Shrinkage

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Purpose: The aim of this study was to determine the original water content of a supplied acrylic resin powder and a monomer and of dry heat–processed acrylic bars. The effect of the original water content of acrylic resin on processing shrinkage was also investigated. **Materials and Methods:** Ten bar specimens were fabricated using dried and as-supplied (control) acrylic resins. The resins were polymerized and cooled, then weighed and measured to determine the amount of shrinkage. The initial water content of the specimens was determined by thorough drying, and results were compared with the Student *t* test. **Results:** The initial water content and processing shrinkage of the dried acrylic resin bars were both significantly lower ($P < .0001$) than those of the as-supplied acrylic resin bars. **Conclusion:** The processing shrinkage of acrylic resin made from dried constituents was significantly less than that of resin made from products as supplied by the manufacturer. However, it is not known if this change is of clinical significance. *Int J Prosthodont 2005;18:420–421.*

Dimensional changes in acrylic resin are mainly attributed to polymerization during processing and water uptake during water immersion.[1–5] These changes affect the accuracy of fit of dentures, resulting in compromised retention and stability.[6,7] The reported values of processing shrinkage range from 0.26% to 1.20%, but most fall into the range of 0.3% to 0.5% for wet heat–processed acrylic resins.[8–15] Unprocessed acrylic resin as supplied by the manufacturer inevitably contains water. It is not known whether eliminating the initial water could produce a better fitting denture. Thus, the purpose of this study was to determine the original water content of the supplied acrylic resin powder and monomer, and the initial water content of the dry heat–processed acrylic bars. The effect of the original water content of acrylic resin on processing shrinkage was also investigated.

Materials and Methods

Polymer beads were dried by silica gel in a desiccator at 37°C until they reached a constant mass between successive weighings. The monomer was dried by molecular sieve and its water content was determined by Karl Fischer titration.

Twenty bar specimens were fabricated using dried (n = 10) and supplied (control; n = 10) acrylic resins in stainless steel molds with reference crosses. The resins were polymerized in a hot-air oven and were allowed to cool slowly inside the oven until they reached ambient temperature. The specimens were weighed after deflasking, and the distances between the reference crosses were measured with a traveling microscope. The initial water content of the specimens was determined by thorough drying. The data were compared using the Student *t* test.

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Results

The original water content of the supplied polymer powder and monomer liquid were 0.8 mass% and 0.06 mass%, respectively. The initial water content (0.10 mass%) and processing shrinkage (0.36%) of the dried bars were both significantly lower ($P < .0001$) than those of the as-supplied acrylic resin bars (0.71 mass% and 0.40mass%).

Discussion

This study indicated that both the supplied polymer powder and monomer contained water (0.81 mass% and 0.06 mass%, respectively). No previous studies had suspected or demonstrated that water could be present in the powder, and particularly in the monomer.

The processing shrinkage of acrylic resin made from dried constituents was significantly less than that of resin made from products as supplied by the manufacturer. However, it is not known if the improvement of processing shrinkage from 0.40% to 0.36% upon drying of polymer powder and monomer is of clinical significance. Nevertheless, if prevention of moisture contamination is desired, the manufacturer may consider supplying the powder in small sealed packages. Alternatively, drying agents such as silica gel, similar to those used for food packages, may be used.

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Literature Abstract

Fracture resistance of 3 all-ceramic restorative systems for posterior applications

Recently, new dental materials and techniques have been introduced to fabricate esthetic ceramic restorations with improved strength and marginal adaptation. The purpose of this study was to compare the fracture resistance and origin of failure of simulated first molar crowns fabricated using 3 all-ceramic systems: IPS Empress 2, Procera AllCeram, and In-Ceram Zirconia. Fifteen all-ceramic crowns were fabricated from each system. The crowns were cemented onto resin dies for comparison of compressive failure load. Following failure, the specimens were analyzed to determine the origins of failure. Five additional specimens from each all-ceramic system were sectioned to determine the thickness of the veneer porcelain, core ceramic, and luting agents layers. Estimates of Weibull modulus and characteristic failure load were used to analyze fracture resistance. Two-way multivariate analysis of variance (MANOVA) was used to analyze the thickness of the luting agent, ceramic core, and veneer porcelain layers at each location. Results showed that In-Ceram Zirconia crowns had the highest characteristic failure load with the lowest variation in failure load. The origin of failure was most commonly found at the interface between the ceramic core and veneer porcelain for IPS Empress 2 crowns and between the ceramic core and luting agent layer for the other systems. There was a great variance of luting agent layer thickness space between different locations on IPS Empress 2 specimens. The mean luting agent layer thickness values for Procera AllCeram and In-Ceram Zirconia specimens were equal to or less than those for IPS Empress 2 specimens.

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