2731 Study of Residual Monomer with a New Denture Base System

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Objective

A staggering 90% of the denture base materials used throughout the world are based on PMMA (polymethyl methacrylate). The outstanding clinical and processing-related properties as well as the inexpensive availability have allowed the success of this material class to last for more than 75 years. Other material classes, such as composites or UDMA derivatives (UDMA: urethane dimethacrylate) with different polymerization mechanisms (light-curing, microwave-curing, etc.) have been unable to establish themselves on a wide scale in removable denture prosthetics because of recurring problems, such as brittleness, susceptibility to plaque, time-consuming processing and not least the higher price. A true alternative material to PMMA is currently not available.

In connection with denture base resins, when there is a reference to monomers it normally means methyl methacrylate (MMA) which undergoes free-radical polymerization as a result of auto-polymerization or heat polymerization. The conversion of the chemical reaction from MMA to PMMA never covers 100%. This implies that low quantities of unpolymerized MMA are present in all materials containing PMMA. This is also true for industrially polymerized PMMA or composites with PMMA fillers, among them even many so-called hypo-allergenic denture base resins.

In general auto-cured systems contain more residual monomer than heat-cured ones. To keep the risk for patients to a minimum, modern denture systems must be designed in such a way that the residual MMA content in the denture body is as low as possible. In contrast PMMA is toxicologically safe and, besides, demonstrates outstanding clinical properties, such as limited susceptibility to plaque accumulation or colonization of micro-organisms, as well as chemical resistance and a low tendency for discoloration.

Two new denture base materials, which are applied in combination with the new injection technique “IvoBase” are compared to four currently available denture base materials with different curing mechanisms.

Materials and Methods

Method / Material	IvoBase High Impact	IvoBase Hybrid	Palapress vario	PalaXpress / Palajet	PalaXpress ultra / Palajet	Lucitone 199 / Success
Technique	Injection		Pouring	Injection		
Classification acc. to ISO 20795-1	auto-polymerizable, Type 2, Class 1					heat-pol. Type 1, Class 1
Manufacturer	Ivoclar Vivadent		Heraeus Kulzer			Dentsply
Polymer Lot	P66128	NM0188	010665	010157	012001	110112
Monomer Lot			010487	010488	010100	1011233
Mixing Ratio (P/M)	30g / 20ml	34g / 20ml	10g / 7ml	30g / 15ml		21g / 10ml

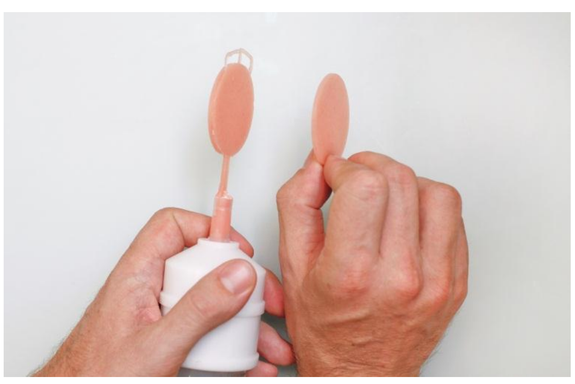
The residual monomer was determined in accordance to ISO 20795-1:2008. 6 different PMMA-based denture base materials (Lucitone 199, Palapress vario, PalaXpress, PalaXpress ultra, IvoBase Hybrid and IvoBase High Impact) were investigated. In addition to the standard techniques, long-term injection was applied with Lucitone 199 and the functional mode RMR (Residual Monomer Reduction) was applied with the IvoBase products. RMR is a development from Ivoclar Vivadent to reduce residual monomer in denture acrylics by controlled application of additional heat during processing. Statistical analysis was carried out with IBM SPSS Statistics (Version 19.0). For the comparison between the different materials, ANOVA with post hoc Dunnett T3 was applied ($p<0.05$).

IvoBase Injector and material capsules / Ivoclar Vivadent

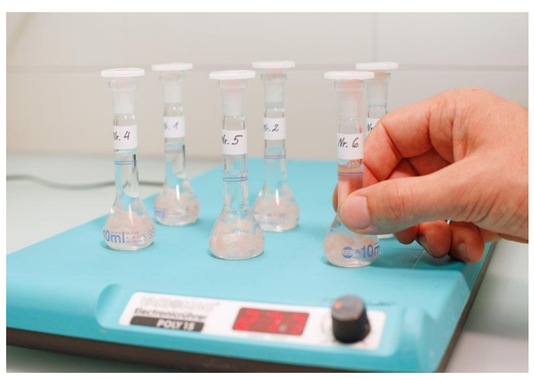
Success Injector with flask / Dentsply

Palajet and Palamat / Heraeus Kulzer

Investment of the silicone spacer to produce the ingot for residual monomer mesurement



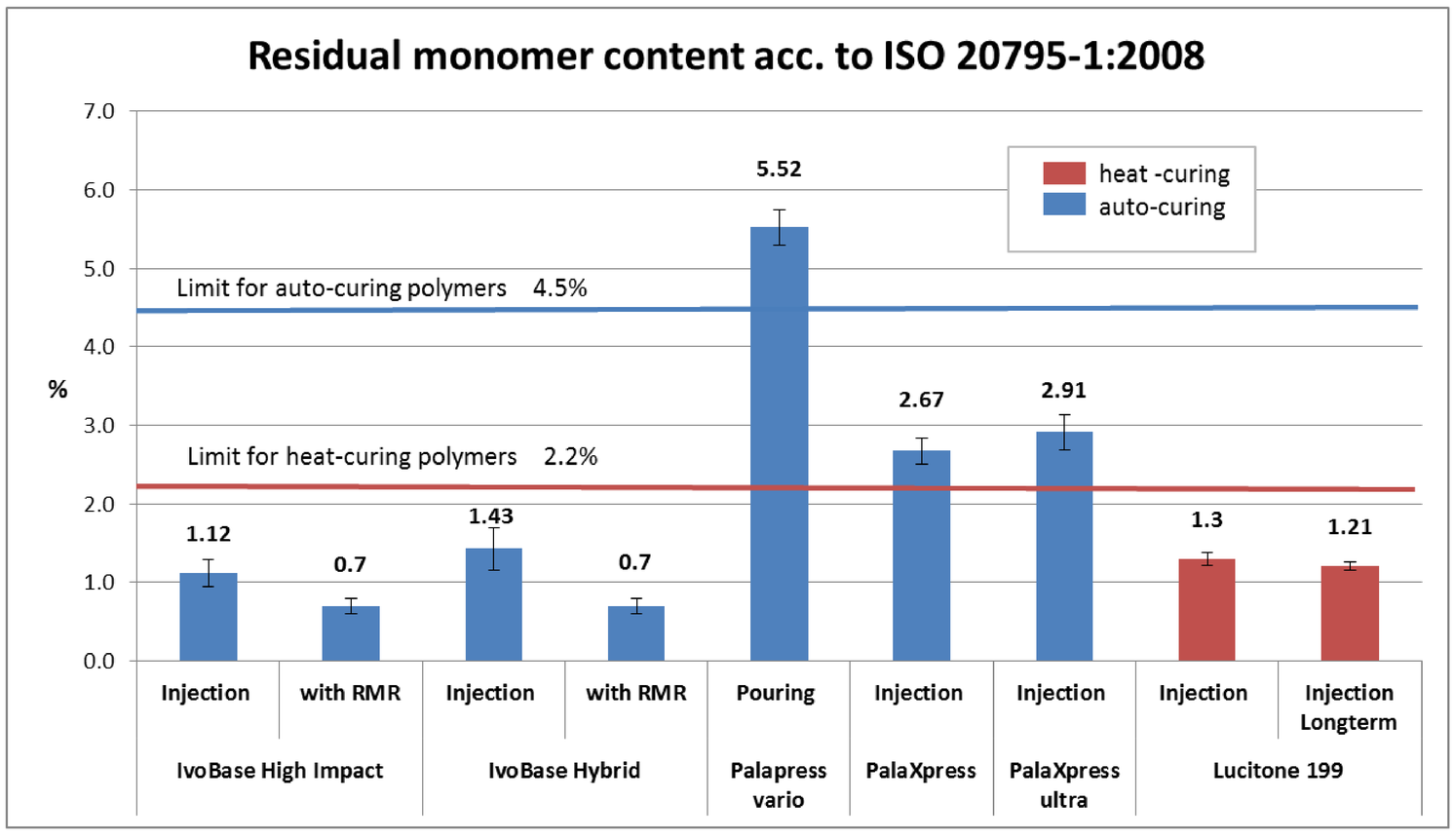
Left: polymerized ingot; right: ground ingot



Extraction of methyl methacrylate by stirring in acetone for 72 hours

Loading the gas chromatograph

Results



PalaXpress ultra and PalaXpress fulfill the requirements for auto-curing acrylics (<4.5% MMA) according to the ISO standard. Palapress vario exceeds this limit. IvoBase High Impact, IvoBase Hybrid and Lucitone 199 fulfill the requirements for hot-curing denture base materials (<2.2% MMA). After application of the RMR functional mode with IvoBase materials, residual methyl methacrylate values significantly decrease compared to standard procedure without RMR ($p<0.05$). Values well below 1 % were achieved.

Conclusion

The new IvoBase System achieves exceptionally low initial contents in residual monomer for auto-curing acrylic system. Conventional auto-curing polymers do not reach such initial values. Consequently, with the IvoBase system the potential sensitization risk for patients can be reduced to a very low level.