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Physical Properties and Toxic Potential of Dental Composites Containing a Triazole-monomer

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INTRODUCTION

Resin-based restorative materials are widely used in dentistry. In general, the resin part of these materials consists of a mixture of methacrylate monomers that are polymerized *in situ* with a blue light initiated free-radical polymerization. The polymerization process never reaches completion, and unpolymerized monomer may be released after curing. The resin composition is a parameter influencing polymerization (degree of conversion; DC), material properties and toxic potential.

The Triazole-monomer 2-[3-(2H-Benzotriazol-2-yl)-4-hydroxyphenyl]ethyl methacrylate (UV090) is a mono-methacrylate monomer used in several commercial materials such as contact lenses and as an UV-absorbant in polymer industry. It has also been used in small amounts in resin-based filling materials. In this study we aim to characterize the physical properties and toxic potential of resin-based dental composites containing different amounts of the Triazole-monomer.

EXPERIMENTAL METHODS

Experimental dental composites containing 70 % inorganic filler, 12.5-15.0 % bisphenol A glycidyl methacrylate (BisGMA), 12.5-15.0 % triethylene glycol dimethacrylate (TEGDMA), 0-5 % Triazole-monomer and initiator components were prepared. The composites (2 mm thick) were cured for 20 seconds using blue light irradiation before the tests.

The degree of conversion (DC) was determined by FT-IR and ATR-method directly after irradiation and after 3 hrs. Flexural strength was determined according to ISO 4049[1] with a Lloyds LRX testing machine. Leakage of unreacted monomer was measured in extracts from cured specimens incubated for 24 h in ethanol/water (75/25 vol/vol) at 37 °C using gas-chromatography.

The toxic potential of the Triazole-monomer was determined by the MTT test (ISO 10993-5[2]).

RESULTS AND DISCUSSON

There were no differences in DC (78 % at 3 h) with the different Triazole-monomer concentrations tested. Decreased flexural strength was observed (figure 1). A possible explanation is that less complete polymer network is formed when substituting the dimethacrylate TEGDMA with the Triazole-monomer (a monomethacrylate).

The leakage of the Triazole-monomer was significantly higher for the composite with 5% of the monomer, while there was no change in the leakage of TEGDMA (figure 2).

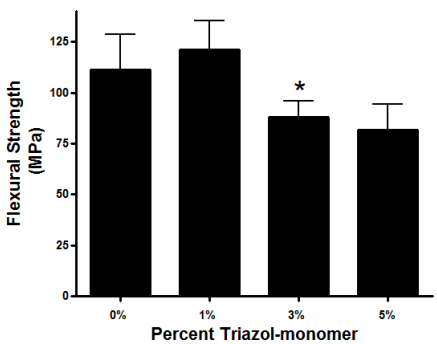

Figure1. Flexural strength was measured with three point bending according to ISO 4049.

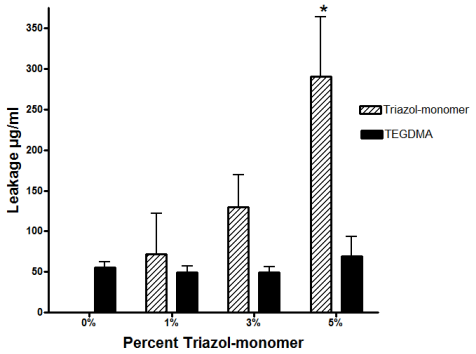

Figure 2. Leakage of unreacted TEGDMA and Triazole-monomer in a mixture of 75/25 ethanol/water (vol/vol) measured after 24h with gas-chromatography.

The MTT test yields a relative number of living cells and showed a dose-dependent decrease of viability in the L929 cells exposed to Triazole-monomer (figure 3). Both cell death and decreased cell growth may be the cause of this finding. HEMA, a widely used monomer in dental composites, showed the same level of toxicity as the Triazole-monomer (200µM) at 50 times higher concentration. Use of flow cytometry indicated an accumulation in the G1-cell cycle phase (data not shown).

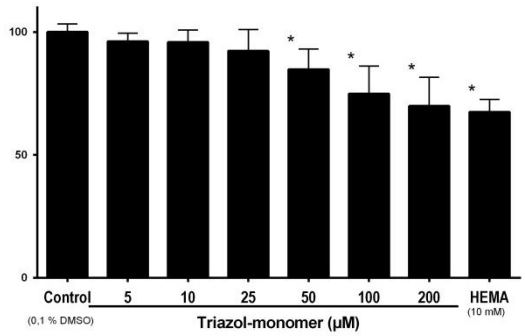

Figure 3. Viability measured with MTT. Triazole-monomer in test-solution reduced the cell viability in a concentration dependent manner.

CONCLUSION

- Addition of the Triazole-monomer to the resin reduced the flexural strength of the composite
- The Triazole-monomer is released from cured composites
- The Triazole-monomer has a toxic potential *in vitro*

In summary, this study showed that increased amounts of the Triazole-monomer negatively influenced the measured properties of the experimental composite.

REFERENCES

1. ISO 4049:2009 Dentistry – Polymer-based restorative materials. International Organization for Standardization, Geneva, 2009.
2. ISO 10993-5:2009 Biological evaluation of medical devices -- Part 5: Tests for in vitro cytotoxicity. International Organization for Standardization, Geneva, 2009.

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