INTRODUCTION

Digital printing of dental restorative devices is now a common place procedure, often performed in the dental office itself. The monomers used to fabricate these devices are NOT similar to those used in conventional dental restorative composites or bonding agents. For restorative resins, methacrylate-based, difunctional monomers (such as Bis-GMA, TEGDMA, and UDMA) are commonly used, and are widely accepted. However, use of acrylate-based monomers is not accepted, based on their high levels of toxicity, not only to the host, but also to the environment: notably to aquatic life. Although acrylate-based resins provide much faster polymerization, they also result in less rigid polymers than do their methacrylate-based equivalents.

Not until recently has the FDA-accepted selected dental 3D print resins for intra oral use. The primary aspect that has led to difficulty in marketing such a dental resin is the need to substitute the usual acrylate-based monomer system, for one that is methacrylate-based, and is thus less toxic.

It should be emphasized that the polymer arising from either type of compound is not cytotoxic — it is the monomer composition that poses toxicity potential. Although the FDA has approved some dental 3D printed formulations for clinical use, the duration that the device is expected to be in the oral environment is still a controlling factor. Class Ia materials (short term) are designated for limited time in a patient’s mouth (surgical guides, impression trays), while Class Ila resins are approved for longer (long term) intraoral wear: dentures, aligners.

Currently there is an extremely wide variety of 3D printable resins from which to choose, and the exact composition/classification (acrylate/methacrylate) seems to be a well-guarded secret. However, because the ultimate physical and biocompatible properties of the printed form are the direct result of the extent of curing during the initial printing, as well (and most importantly) from the subsequent method used for post-curing of the printed item, knowledge of the composition of the resin material seems to be of primary clinical importance.

METHODS

LITERATURE UPON WHICH INFRARED ANALYSIS WAS BASED

DENTAL 3D PRINTING RESINS TESTED
SPRINTRAY (Clear Surgical guides; Gray, models)
NEXTDENT BASE (denture), NEXTDENT ORTHO-IBT
OCTAVE LIGHT – White (model)

UNCURED RESIN PLACED IN DIAMOND ELEMENT OF A HORIZONTAL ATTENUATED TOTAL REFLECTANCE (ATR) ATTACHMENT (Goldengate, SPECAC)

FTS-40 DISKLAB/BORAD FTIR SPECTROMETER

IR SPECTRA COLLECTED: 16 SCANS AT 2cm-1 RESOLUTION

SPECTRA COPIED INTO EXCEL

STANDARD MONOMERS TESTED: Methyl acrylate, Methyl methacrylate

ABSORPTION PEAK WAVELENGTHS OF KNOWNS AND UNKNOWN S COMPARISONS FOR PURPOSES OF CLASSIFYING AS ACRYLATE- OR METHACRYLATE-BASED RESIN

CONCLUSIONS

1. Only one product (White Model Resin) demonstrated presence of strictly an acrylate-based monomer. Not intended for intraoral use.
2. Some products demonstrated they were methacrylate-based (for intraoral use) – Surgical guide, Denture base (for extraoral use): Grey model resin
3. Surprisingly, one product indicated a possible mixture of acrylate and methacrylate-based resins: Ortho resin, designated for intraoral use
4. Not all resins indicated for intraoral use (Ortho Resin) were strictly methacrylate-based