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DIRECT PRINTING OF 2-COMPONENT SILICONES IN FACIAL & BODY PROSTHESES

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Traditionally maxillofacial prostheses are fabricated by hand carving the missing anatomical defect in wax, and creating a mould into which pigmented silicone elastomer is placed. Modern technologies have been used to manufacture anatomical face/body parts utilizing computed tomography (CT) data in conjunction with rapid prototyping (RP) techniques utilizing a hard plastic resin or thermoformed wax. However, these methods still require moulds into which a biocompatible pigmented silicone elastomer is placed. The purpose of this paper is to explore the development of direct printing of two component silicone elastomers in conjunction with a PVA support structure to create complex shapes using a customized 3D printer.

A custom designed 3D printer with x- y-z gantry robot with an accuracy of 0.1µm was adapted with a custom designed printing head. Secondly, a two-component printable silicone elastomer was formulated that incorporated the desired characteristics and properties similar to those commercially available for the provision of facial and body prostheses. The silicone is composed of polydimethylsiloxane (PDMS) chains, filler, catalyst and cross-linker. Varying the amount of these components the mechanical properties of the silicone elastomer can be altered e.g. tensile strength, tear strength, hardness and wettability. To achieve these desired properties consideration must also be given to the set time and viscosity of the silicone elastomer and additionally the speed at which the material is printed. A thermal print head was used to deliver Polyvinyl acetate (PVA) to support the complex silicone shapes.

Further development is needed to ensure appropriate digital colouring of the silicone elastomer to match the patients' natural tissues. Ultimately, this would provide the maxillofacial prosthetist with a tool that manufactures prostheses reliably, with less emphasis placed on individual artistic interpretation. This technology has the potential to solve possible manufacturing solutions to complex shapes for both commercial and industry in addition to the current medical applications.