World Academy of Science, Engineering and Technology
International Journal of Educational and Pedagogical Sciences
Vol:11, No:03, 2017

Future Applications of 4D Printing in Dentistry

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Abstract : The major concept of 4D printing is self-folding under thermal and humidity changes. This concept relies on understanding how the microstructures of 3D-printed models can undergo spontaneous shape transformation under thermal and moisture changes. The transformation mechanism could be achieved by mixing, in a controllable pattern, a number of materials within the printed model, each with known strain/shrinkage properties. 4D printing has a strong potential to be applied in dentistry as the technology could produce dynamic and adaptable materials to be used as functional objects in the oral environment under the continuously changing thermal and humidity conditions. The motion criteria could override the undesired dimensional changes, thermal instability, polymerization shrinkage and microleakage. 4D printing could produce restorative materials being self-adjusted spontaneously without further intervention from the dentist or patient; that is, the materials could be capable of fixing its failed portions, compensating for some lost tooth structure, while avoiding microleakage or overhangs at the margins. In prosthetic dentistry, 4D printing could provide an option to manage the influence of bone and soft tissue imbalance during mastication (and at rest) with high predictability of the type/direction of forces. It can also produce materials with better fitting and retention characteristics than conventional or 3D-printed materials. Nevertheless, it is important to highlight that 4D-printed objects, having dynamic properties, could provide some cushion as they undergo self-folding compensating for any thermal changes or mechanical forces such as traumatic forces.

Keywords : functional material, self-folding material, 3D printing, 4D printing
Conference Title : ICDDHEOH 2017 : International Conference on Dentistry, Dental Health Education and Oral Hygiene
Conference Location : London, United Kingdom
Conference Dates : March 14-15, 2017