Stereolithography and Biomodeling

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Abstract- With the inclusion of stereolithography (SLA) for medical purposes, doctors are able to create 3-D lifelike replicas of designated organs of the bodies of patients. Since its introduction, stereolithography has been the most accurate and reliable forms of SFF (Solid Freeform) techniques. Doctors mainly use the 3-D replicas of organs to properly plan surgical procedures before the actual operation. The purpose of this is to provide more accurate medical procedures for the correct patients.

I. INTRODUCTION

In a medical operation for treatment of patients, what surgeons lacked was a careful pre-operative planning on how to properly treat the patient before the introduction on stereolithography in the medical field. Stereolithography involves the generation of 3-D models based on data collected by CAD (computer assisted by design). In terms of pre-operative procedures on patients, the 3-D models display any specific anatomical structures in the body of the patient and its deformities. Surgeons are able to plan their procedures for any deformities any structure of the human body such as the skull, brain, or spinal cord. This process is particularly useful since surgeons have limited information on deformities in anatomical structures of patients or how to provide treatment without proper planning.

II. METHOD

The generation of 3-D product via stereolithographic devices relies on data collected by computed tomographic (CT) scans or any 3-D scans. This process requires photopolymer resin and ultraviolet (UV) laser. After the data is collected, the UV laser points at the photopolymer resin and produce very thin slices of solid material. Through photo-polymerization, the liquid resin to solidified material. The stack of solid material generated from the bottom-up of the surface below the resin by the UV laser would then become the 3-D product during fabrication.

III. RESULTS

In 2013, the concept of 3-D modeling was used on three patients who experienced combat-related injuries to certain parts of their bodies to treat heterotopic ossification. The first patient had a fracture in the right femur and surgeons were uneasy on how to treat the area of heterotopic ossification which is close to the femoral bypass graft. With 3-D modeling, surgeons can pinpoint exactly where the bypass graft is exactly is in the patient’s femur. With this, surgeons can safely reduce dissection around the bypass graft as much as possible and treat the heterotopic ossification. This process is also used to treat the other two patients who have similar deformities. 3-D modeling provides surgeons with an operative reference in which they represent the deformities of patients’ anatomical structures perfectly.

IV. DISCUSSION

The implementation of stereolithographic devices to medical operations has been a significant benefit to the medical field in terms of clinical surgeries. The 3-D products of the data from CAD give surgeons an accurate reference to the deformities of the particular body part. This allows surgeons to have accurate diagnosis and to think of a preoperative plan on how to precisely treat the patient with as less dissection as possible. One of the limitations of stereolithography is that photopolymer resin are commercially limited and extremely expensive which is between $300 and $800 per gallon. Another limitation is that stereolithography machines cost between $100,000 and $500,000.

REFERENCES