Mandibulectomy Prosthetic Case Report: Comparison of Traditional and Digital Fabrication Methods with 3DMD Face Scanning, Digital Sculpting, and 3-Dimensional Printing

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INTRODUCTION

Maxillofacial silicone elastomer prostheses are used to replace facial features congenitally absent, surgically removed due to disease, or lost because of trauma. Traditional prosthetic fabrication (impression, wax-up, mold fabrication, and silicone processing) can be streamlined using digital scanning, and computer-assisted design and manufacturing. The purpose of this report is to improve traditional facial prosthetic workflow using facial scanning, digital prosthetic design, and 3-dimensional printing technology. In this clinical case report, we present two design and fabrication protocols for mandibulectomy prosthesis: traditional versus digital modeling and 3D printing.

CASE HISTORY

67-year-old male. History of T2N0M0 squamous cell carcinoma left lateral tongue treated with implants, brachytherapy, and external beam radiation therapy late 1990s. Previous tracheostomy. Developed T1N0M0 squamous call carcinoma right oropharynx treated with upfront surgery.

Adjuvant radiotherapy due to perineural invasion. Soft tissue necrosis led to resection and intraoperative radiation therapy with right-sided pectoralis major flap. Wound breakdown led to large amount of exposed mandible and persistent issues with aspiration pneumonia and large fistula in right submandibular area. Laryngectomy for dysfunctional larynx. Attempted fibular free flap failed due to arterial compromise and osteoradionecrosis.

METHODS

Traditional: PVS impression (Factor 2: Lakeside, AZ) of defect. Cast in Type IV dental stone (Silky Rock, Whip Mix Corp: Louisville, KY). Sculpting clay (NSP by Chavant: Farmingdale, NJ) for prosthetic modeling based pre-surgical patient photos. VST50 silicone for final prosthesis (Factor 2: Lakeside, AZ).
Digital: Pre-surgical CT for digital prosthetic modeling not clinically acceptable due to insufficient soft tissue data. 3-D stereophotogrammetry using 3dMDface (3dMD: Atlanta, GA). Zbrush digital sculpting software (Pixologic: Los Angeles, CA) to optimize data, detail prosthetic features, and prepare mold for FDM 3D print.
3D Printing: Fused Deposition Modeling (FDM) with commercial 3D printers (Makerbot: NewYork, NY; Formlabs: Somerville, MA). Polylactic Acid (PLA) printing for lightweight, customizable, iterative, and affordable molds.

TRADITIONAL

DIGITAL
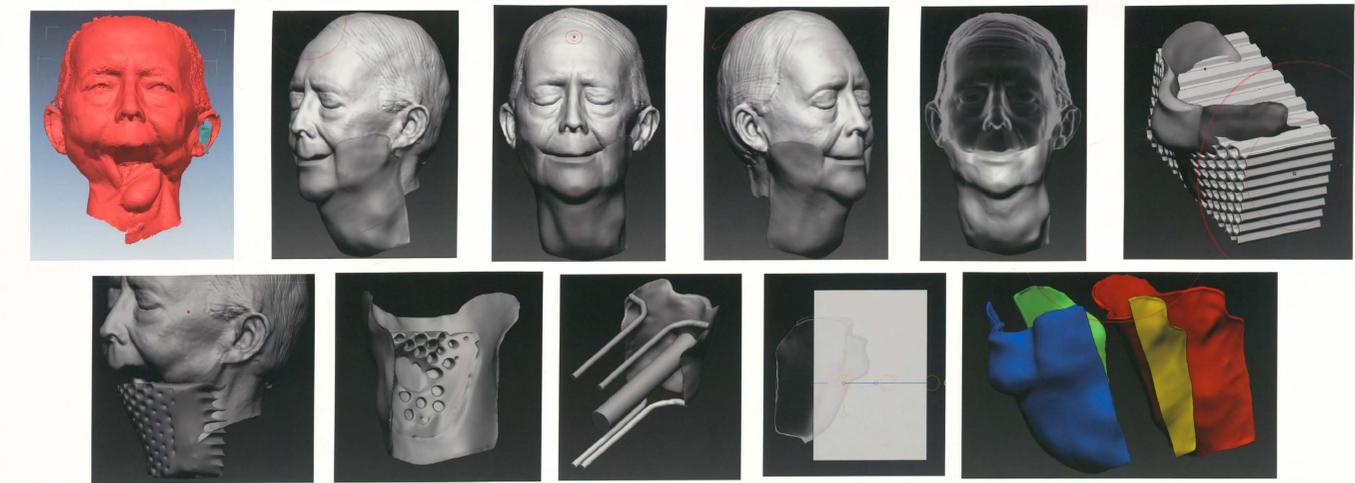
3-DIMENSIONAL PRINTING
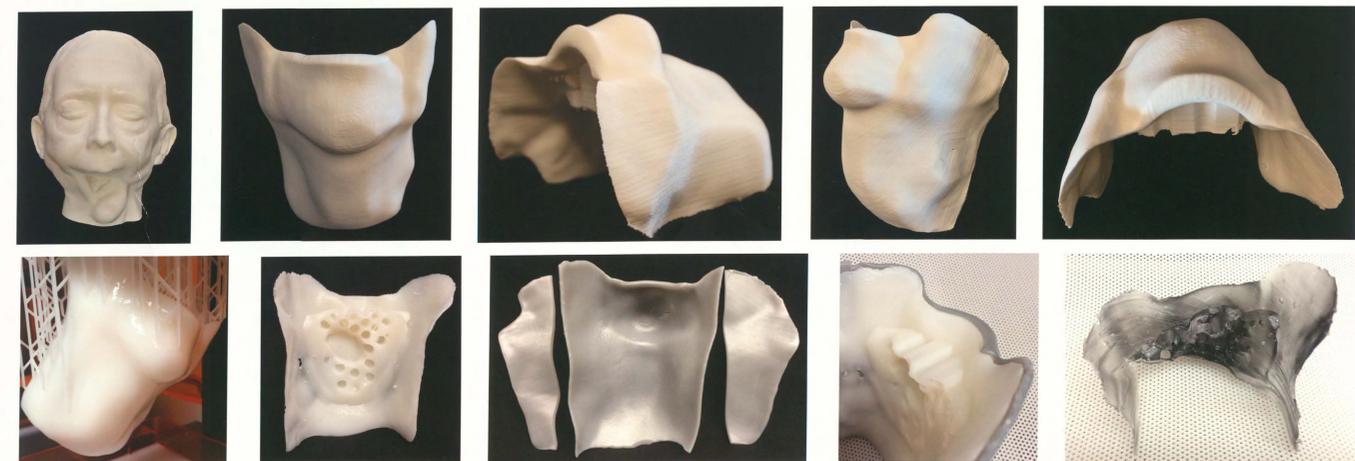
CONCLUSION

Traditional mandibular prosthetic fabrication (impression, wax-up, mold fabrication, and silicone processing) may be streamlined using digital scanning, digital sculpting, and fused deposition modeling.

This technology helps avoid soft tissue distortion, reduce cost, save time, and improve prosthetic predictability. Digital technology improves patient experience by eliminating the arduous impression process and reducing required office visits.

Due to complexity and cost of maxillofacial prosthetic design and fabrication applications, a fully digital workflow for a mandibular prosthesis of this size and complexity is significantly improved using digital sculpting software not limited by the mathematical-based constraints in engineering software.

Based on this clinical case report, a combination of photogrammetric imaging and digital sculpting overcomes challenges in digital design, improves patient experience, and provides more predictable prosthetic outcomes.

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