3D-Printed Palatal Obturators for Pediatric, Bilateral Cleft Patients

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### Medical Need

- **Cleft Palate:** Most common congenital craniofacial abnormality that occurs in 1 in every 700 live births
  - **Alveolar arch collapse** can occur due to inadequate intraoral support
  - Without treatment, midface deficiency, collapsed dental arches, and the malformation of teeth can occur
  - 44% of patients turned away from treatment in developing countries
  - Existing solutions include a lengthy fabrication process involving impression/casting/molding, which is expensive and time consuming

### Project Goal

Create a palatal obturator design with a 3D-printable material that will prevent alveolar arch collapse for preoperative bilateral cleft patients in ages ranging from 7-11

### Finite Element Analysis

- 3D prototype imported into ANSYS software to analyze stress and deformation heatmaps

### Solution

- **3D Oral Model from Medical Scan**
- **3D Personalized Obturator Prototype**
- **3D Prototype on Patient Palate**

### Requirement | Orientation | Acceptance Criteria
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Withstand 1.2 N load cheek force | Side to side (medial to lateral forces) | < $8 \times 10^{-3}$ mm displacement bottom face
Withstand 0.68 N load tongue force | Dynamic vertical loading during chewing and swallowing | < $6.5 \times 10^{-3}$ mm displacement sides

### Testing Results

- Tongue force verification testing negligible - simple compression test
- 6-run cheek force verification testing - **PASS**

### Impact & Future Plans

- This non-invasive solution utilizes 3D-printing and engineering simulation software to fabricate palatal obturator designs leading to more efficient processes
- Fast turnaround to treat patients in developing countries
- Automation of prototype production for future innovations

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Bilateral cleft palate  
Palatal obturator

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3D Oral Model  
3D Personalized Obturator Prototype  
3D Prototype on Patient Palate

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Tongue force deformation heatmap  
Cheek force deformation heatmap

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Obturator Material - Stratasys Veroblue RGD840

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Uniform 4.0 mm thickness  
Single component