Bringing New Hope to Burn Victims

Hong Kong Polytech University Doctor 3D Prints Face Masks to Treat Burn Scars.

Every day, more than 30,000 people suffer from burn injuries around the world, with a significant percentage of these being facial burns. These often cause hypertrophic scarring, characterized by thickened and raised skin that is often both physically and psychologically damaging. Children are especially prone to emotional trauma as a result of facial burns, which can negatively affect relationships with peers. Dr. Wei Yating of the Second Affiliated Hospital of Kunming Medical University has dedicated her research to correcting hypertrophic scars in young burn victims.

> “The new face mask is convenient to fabricate, and effective in improving and treating facial hypertrophic scars … thereby improving the quality of life for burn survivors.”
>
> Dr. Wei Yating
> **Second Affiliated Hospital of Kunming Medical University**

Case Study

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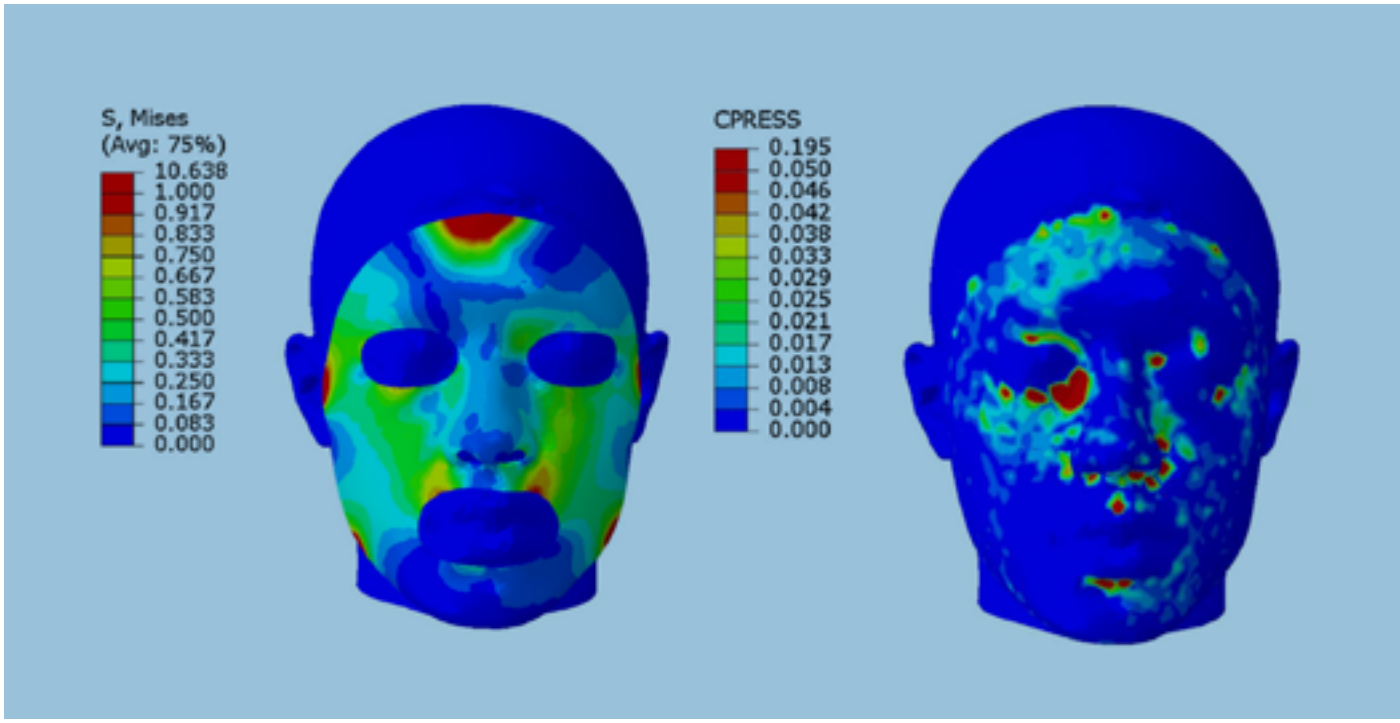


A finite element model depicting uneven pressure forces on a patient's face. 3D printed masks are designed to provide more even distribution for more effective treatment.[1]

The standard treatment for hypertrophic scars is pressure therapy using a face mask. The mask is usually custom made, which requires making an impression of the patient's face and then creating a plaster mold. However, this method has several problems. Because this process is long and often painful, many children need to be put under general anesthesia while the mold is made. This can result in an imperfectly fitted mask because lying down changes the shape of the face slightly. Additionally, fabrication is labor-intensive and complicated, with a high recast rate. Traditionally-made face masks are also opaque and cover the whole head and neck, drawing unwanted attention to the patient. Dr. Wei wanted to find an alternative face mask that could not only solve these problems, but also improve treatment.

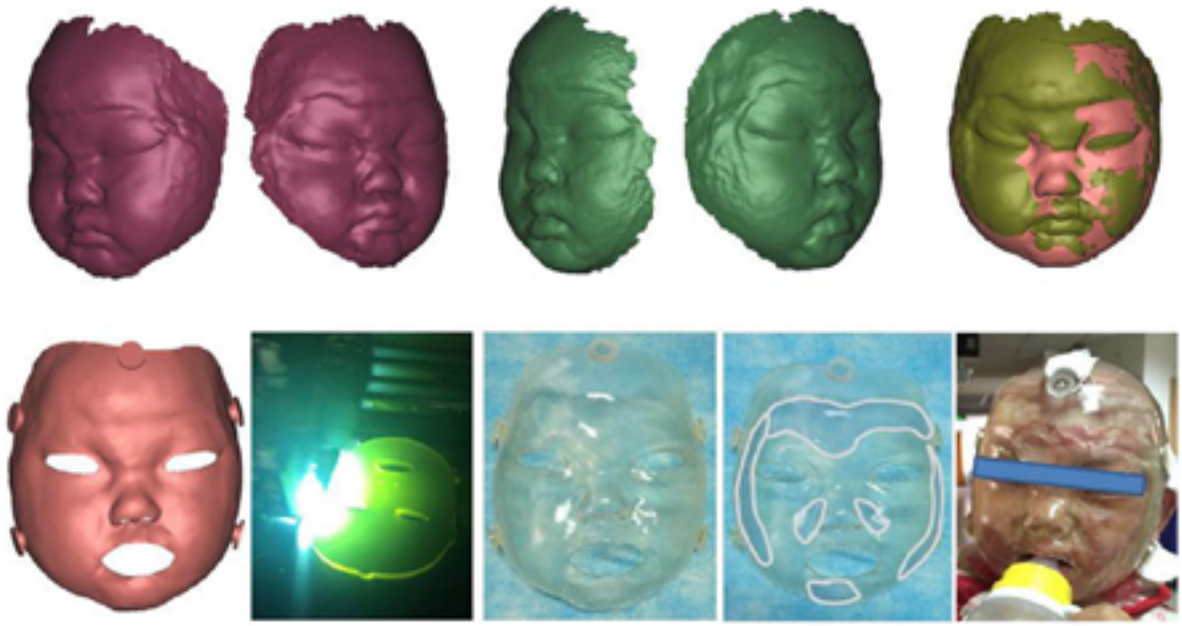
Dr. Wei used the Objet30 Prime to create therapeutic 3D printed face masks.

3D Printing Provides an Alternative Treatment

Because of its easy and non-contact scanning process, Dr. Wei turned to 3D printing technology. In 2017, Hong Kong Polytechnic University launched the University Research Facility in 3D Printing (U3DP), the largest 3D printing research center in Hong Kong. Among the 3D printers installed at U3DP is an Objet30 Prime™. Dr. Wei decided to use the Objet30 Prime because of its ability to print highly-accurate, detailed parts, as well as use biocompatible materials. The material was a critical aspect of this project, so Dr. Wei chose biocompatible MED610™.

In her clinical study, Dr. Wei first used a 3D scanner to scan two young patients' faces from different angles, which could be done while the children were sleeping.

The data was then imported into the CAD software for synthesis. 3D modeling provided an effective visualization of the patients' complex facial structures, reducing impression errors. Dr. Wei was able to customize the 3D files to better facilitate effective pressure therapy, smoothing curvatures to ensure an accurate fit. The Objet30 Prime allows modification to be controlled within 5 mm, which was necessary to avoid geometric deviations. Dr. Wei also designed the anchors and digitally smoothed the surface and edges before printing to make the mask as comfortable as possible. This digital polishing and contour editing significantly helped Dr. Wei simplify the post-processing work and reduce the cost of mask production.



This image shows the process of developing a 3D printed infant mask, starting with facial scans in the upper left culminating in the 3D printed mask creation (bottom row).[2]

A Faster Process and Better Results

While making a plaster mold typically takes 5-7 days, printing the face mask only took one day with the Objet30 Prime. One of the major advantages of the 3D-printed mask is the even pressure distribution, because it is made from rigid thermoplastic materials and compresses the scars through the force generated by the harness straps. Therefore, while the conventional face mask must be extremely tight to achieve adequate pressure onto the concave areas like the lateral sides of the nose, with the 3D-printed mask there is no need to compress the whole head. This means the patients would feel much more comfortable.

Dr. Wei performed follow-ups one and three months after treatment and discovered that there was a significant decrease in average scar thickness and hardness for both patients. The patients experienced significantly higher levels of comfort with the 3D printed face masks, which boosted their parents' confidence in the treatment.

Dr. Wei's research has resulted in two academic publications and brought more attention to the application of 3D printing technology to clinical medicine. "The new face mask is convenient to fabricate, and effective in improving and treating facial hypertrophic scars, while potentially minimizing facial distortion, as well as reducing difficulties associated with reconstructive surgery, thereby improving the quality of life for burn survivors."

This image shows the design of the 3D printed face mask. More pressure will be generated on the pink portions of the mask in areas of greater soft tissue.[1]

A 3D printed mask (left) and shown fitted on the patient (right).[1]

[1] Images courtesy of Y. Wei, et al., The application of 3D-printed transparent facemask for facial scar management and its biomechanical rationale, Burns (2017), http://dx.doi.org/10.1016/j.burns.2017.08.006

[2] Image courtesy of Y. Wei, et al., 3D-printed transparent facemasks in the treatment of facial hypertrophic scars of young children with Burns, Burns (2016), https://www.sciencedirect.com/science/article/abs/pii/S0305417916303424

Stratasys Headquarters

7665 Commerce Way,
Eden Prairie, MN 55344
+1 952 937-3000 (Intl)
+1 952 937-0070 (Fax)

1 Holtzman St., Science Park,
PO Box 2496
Rehovot 76124, Israel
+972 74 745 4000
+972 74 745 5000 (Fax)

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