Letter to the Editor

ABPL RECON F1: Prototype of an Innovative Model of the Face for Teaching, Training, Simulation, and Patient Counselling

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DEAR EDITOR-IN-CHIEF

A wide range of tools may be used to facilitate medical student and surgical resident education and training. The use of simulation, for both training and measurement of competence, has assumed importance. It is proven that simulation has a beneficial role in surgical training[1]. Simulation on 3D printed anatomical models could result in improved surgical planning and execution skills, which in turn, can translate into safer, shorter operations with improved patient outcomes[2]. Apart from this, educating the patient and/or the relatives about the defect/deformity being addressed and explaining the possible surgical interventions and potential outcomes is important. While photographs of previous similar cases are commonly used, the usage of 3D-printed physical models will be a valuable addition to this process. Physical models have many potential advantages over photographs, as they help the patients get a more realistic, visual, and palpable understanding of their condition and the proposed treatments.

In this article, we report our innovation, a model of the human face, which has its basis in anatomy, was manufactured using 3D printing technology. It can be used for medical education, training, simulation, and patient counselling.

The model is a 3-dimensional jigsaw with individual pieces corresponding to the facial aesthetic sub-units[3]. The basic model of the human face was created by an independent designer (LS). We gave inputs for the cuts of the facial aesthetic sub-units to be incorporated into the original model. The final output was provided in the form of an STP (Standard for the Exchange of Product Data) file by the designer. Two important technical considerations were taken care of during the design stage:

1. For the jigsaw to assemble properly, 200-300 micron (0.2-0.3 mm) clearance was needed between each of the pieces.
2. To reduce the material needed, the model was hollowed out and an internal support structure was added.

This STP file was then sent to a 3D printing company, which further processed the model and printed it using "Fractal Works Julia Extended Printer", manufactured by Fractal Works Ltd. Polylactic acid (PLA) material was used for the process. After printing, the model was

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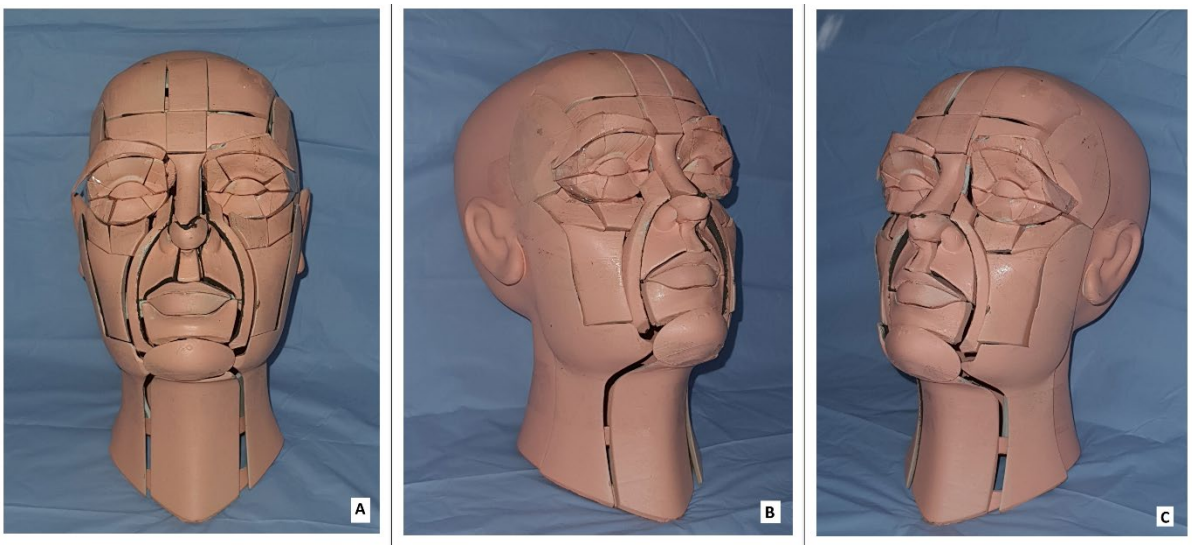


Figure 1: The complete assembled model.
A: Frontal view B: Right oblique view C: Left oblique view

further processed with sandpaper and putty and was colored. Figure 1 shows the final appearance of the assembled model. We have named it the ABPL RECON F1.

This model will have diverse applications in education, training, simulation, and patient counselling. Firstly, it can be used to teach the anatomy of the face and the concept of aesthetic facial sub-units to medical students and surgical trainees. By removing one or more pieces of the jigsaw, various kinds of sub-unit defects can be created on the model. This is not only useful for pre-operative planning and simulation but also is quite handy for patient counselling. This model would also be useful in teaching/planning/patient counseling regarding incisions/scars.

3D printed anatomical models are being used for medical education, preoperative planning, simulation, clinical research, and patient counselling [4–6]. 3D printed anatomical models are useful in learning human anatomy in medical students and surgical trainees [7]. These models were superior to the use of 2D images and made learning anatomy more enjoyable [7]. Compared to 2D images and 3D visualizations on a computer screen, trainees would benefit more from physical models that they would be able to handle and practice surgery upon. The possibility of developing pathological models for surgical simulation is an area that needs to be explored further. Our innovation can serve as an anatomical model. It can also be used as a pathological model on which various defects of the face can be simulated. Reconstruction can be planned as well. 3D printed models when applied in the pre-operative setting improved clinical understanding. 3D printed models were superior to 3D imaging in knowledge-based assessment and understanding of the surgical procedure [8]. These models not only stimulate the visual system of the trainees but also engage their tactile responses, which may be closer to the situation in the operation theatre [8].

Zhuang et al. have shown that 3D printed models enhance communication between patients and surgeons. They allow close observation and touch, providing visual and haptic value, which enhances patients' understanding[9]. These models can show a defect and its relation to the rest of the body, thus allowing patients and other family members to understand the physical nature of the condition. This would facilitate an easier explanation of the complexities of the defect. Compared with the more traditional pre-operative communication, they improve the process of patients' consent[10]. Surgeons can visually demonstrate the surgical process with the aid of these models, thereby facilitating the explanation of surgical procedures. They can also be used to explain the possible risks and complications in an easier way to the patient [9]. Our model can achieve all these purposes related to patient communication effectively.

In conclusion, the ABPL RECON F1 is a prototype of an educational tool with multiple potential

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applications in medical education, surgical training and simulation, and patient communication. This model has the potential for improvisation and development and further venues should be explored.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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