3D-Printed Tool for Creating Standardized and High-Throughput Burn Wounds in *Ex Vivo* Human Viable Skin Tissues

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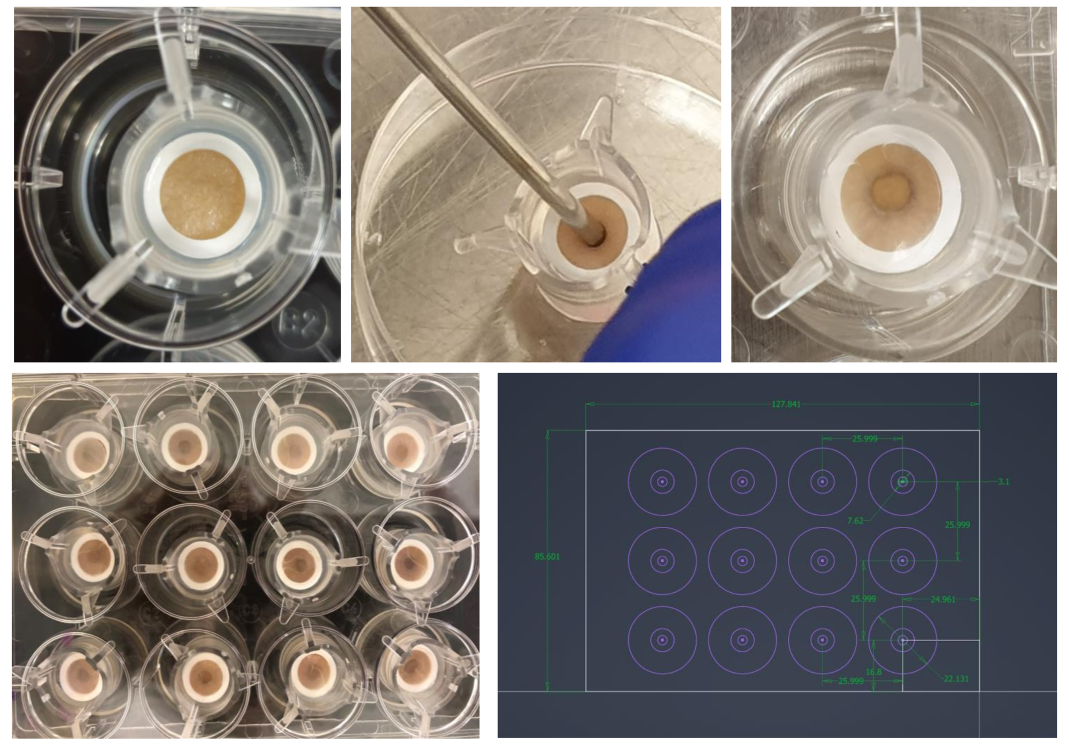
Introduction

Development of biomaterials and medical devices for burn wound treatment necessitates thorough investigation through *in vitro*/*ex vivo* models before transitioning to animal studies. Creating uniform and consistent burn wounds in *ex vivo* human skin tissues is a critical step in burn wound research. However, traditional methods often struggle to maintain consistent wound size and shape while minimizing user influence. Our objective was to address this challenge by developing a practical and cost-effective 3D-printed burn wound tool capable of uniformly inducing burns in 12 skin samples simultaneously.



Methods

1) Sketching: Initial design concepts were sketched to explore various mechanisms for controlling rod height and pressure on skin tissues.

2) Designing the 3D model and Prototyping:

- Design based on 3D *ex vivo* viable skin tissues and 12-well inserts.
- Utilized Autodesk Inventor to create the tool components:
  - Rod-Base Component (RBC) housing stainless steel rods.
  - Plate-Base Component (PBC) for holding skin samples.
- Prototyped initial designs and refined based on performance analysis.

3) Conversion to G-code:

- Converted final designs to .stl file format within Autodesk Inventor Pro.
- Imported .stl files into AnkerMake 3D printing application.
- Adjusted size and unit dimensions.
- Sliced models and generated G-code for printing.

4) Final Model Printing & Assembly:

- Printed Rod-base component with precision mode, 0.12mm layer height, and 80% infill.
- Printed Plate-base component with precision mode, 0.12mm layer height, and 60% infill.
- Allowed models to cool for 20 minutes before detachment.
- Assembled the tool by delicately inserting steel rods into the Rod-Base component using a hammer.

Results

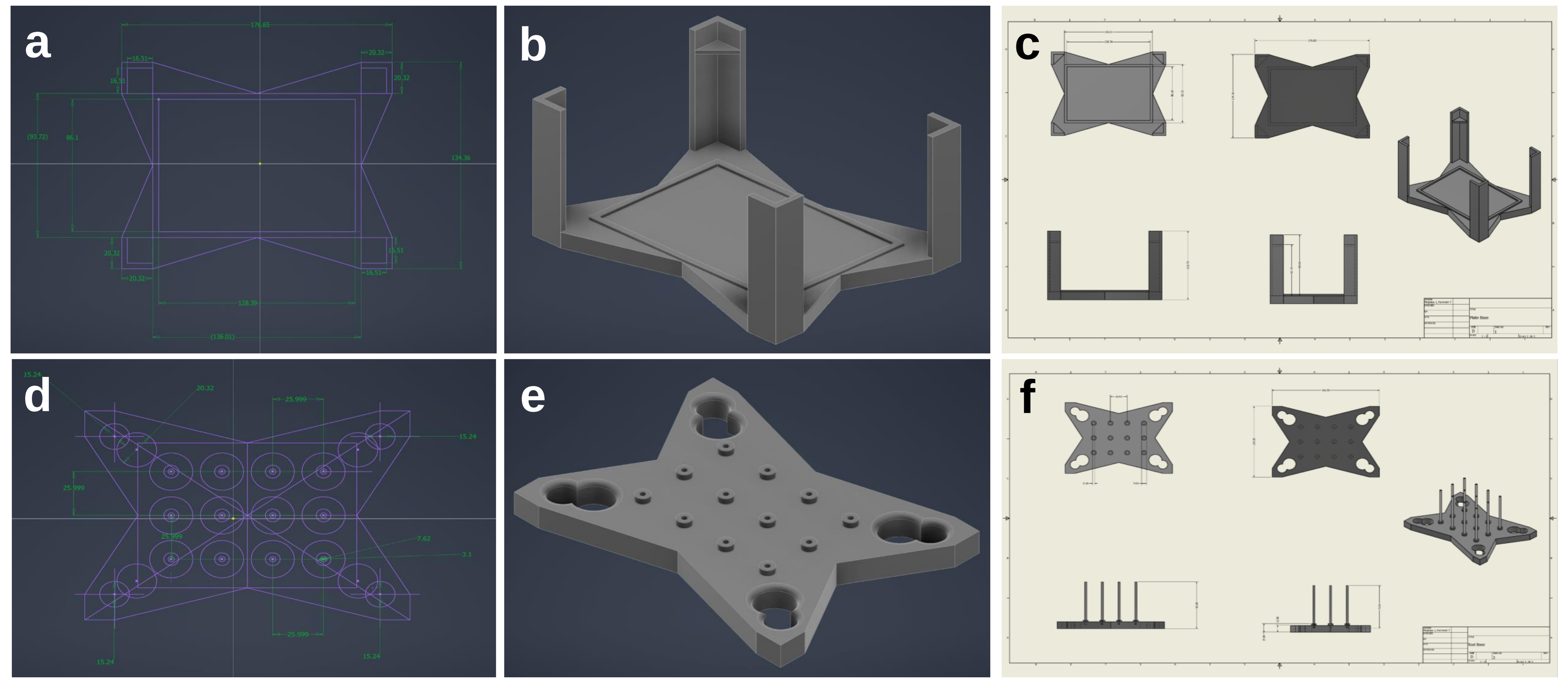


Figure 1. PBC and RBC design: a) The base sketch of the PBC, b) The final design of PBC, c) Schematics of the final version of the PBC, d) Base design sketch of the RBC, e) The final design of RBC, and f) Schematic of RBC with rods.

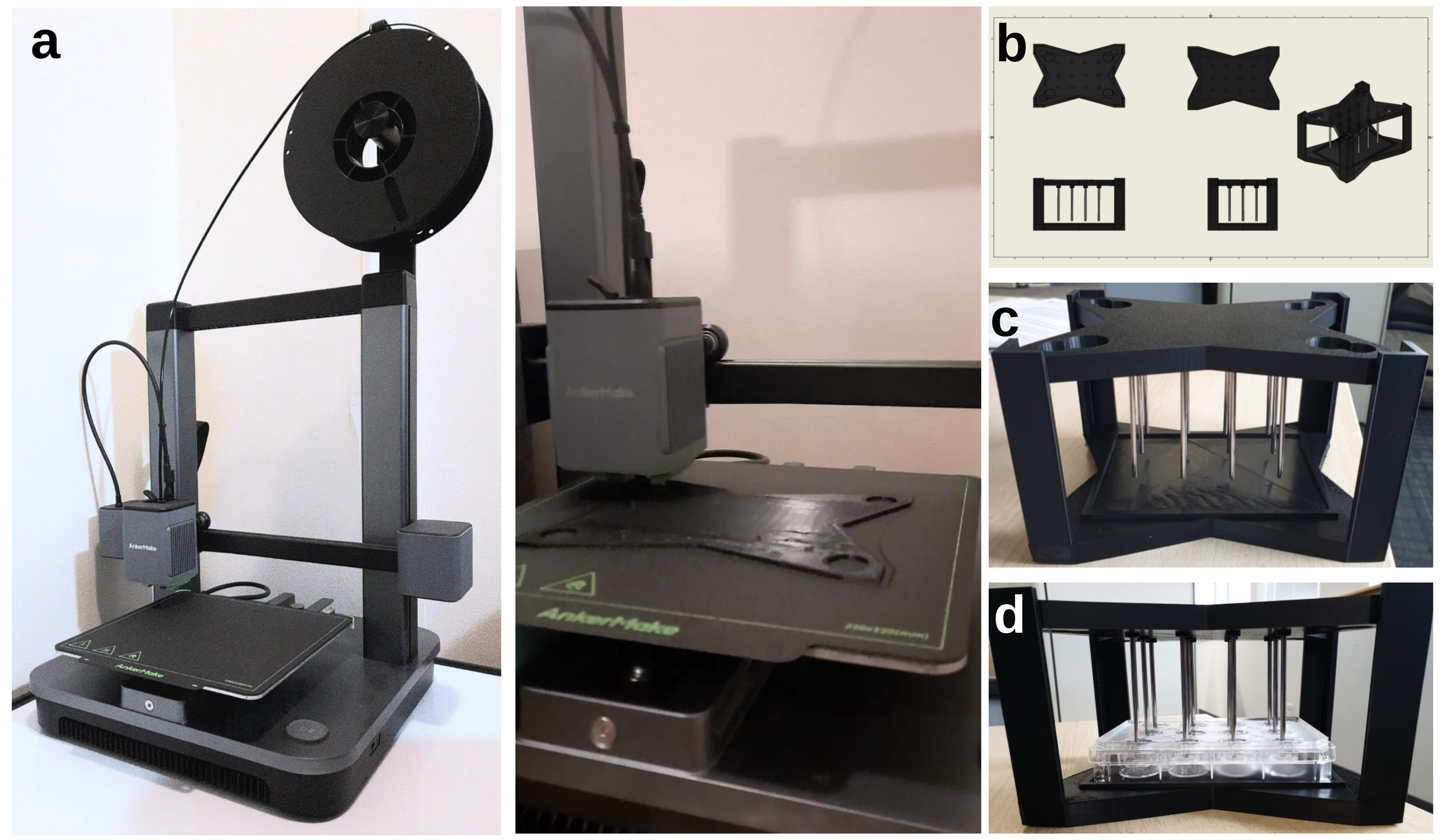


Figure 2. 3D printer and 3D printing of rod component (a); Schematic of the assembled device (b), Physical model of the completed burn wound tool (c), and its interaction with a 12-well plate (d).

Conclusion

We explored the production of an innovative, high-throughput, and cost-effective 3D-printed tool specifically designed for efficient burn wound creation on viable human skin tissues. Unlike traditional methods, our tool streamlines the process by concurrently generating uniform wounds in 12 samples, reducing creation time by 70-80%. With consistent pressure and heat distribution, it ensures reproducible results, minimizing experimental variability. These high-throughput capabilities enhance data reliability and pave the way for advancements in burn wound research. Future iterations promise even greater flexibility and efficiency, propelling advancements in biomaterials and treatments for addressing burn wounds.

ABOUT iFyber

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