

# 3D Printed Electron Plaque

## E-xact Shapes

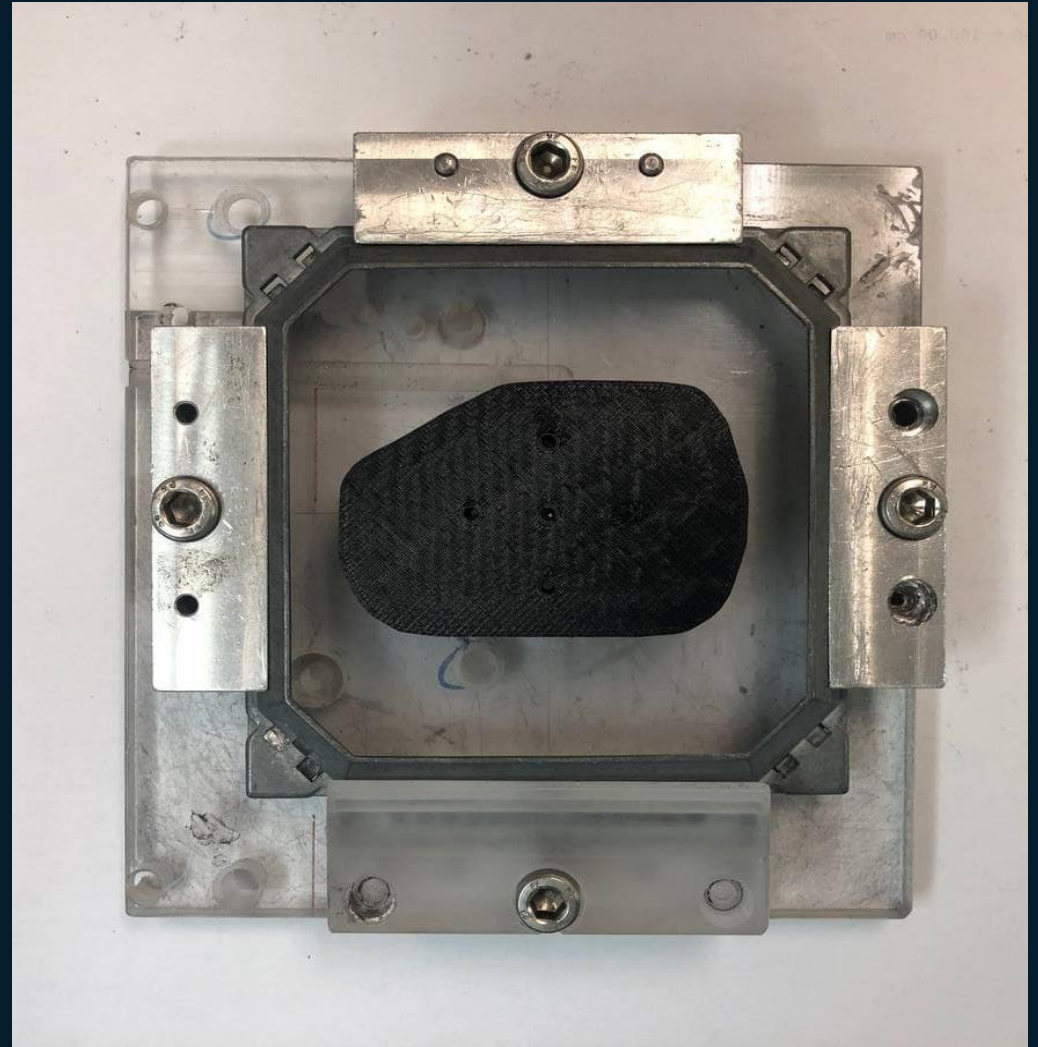
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# Background

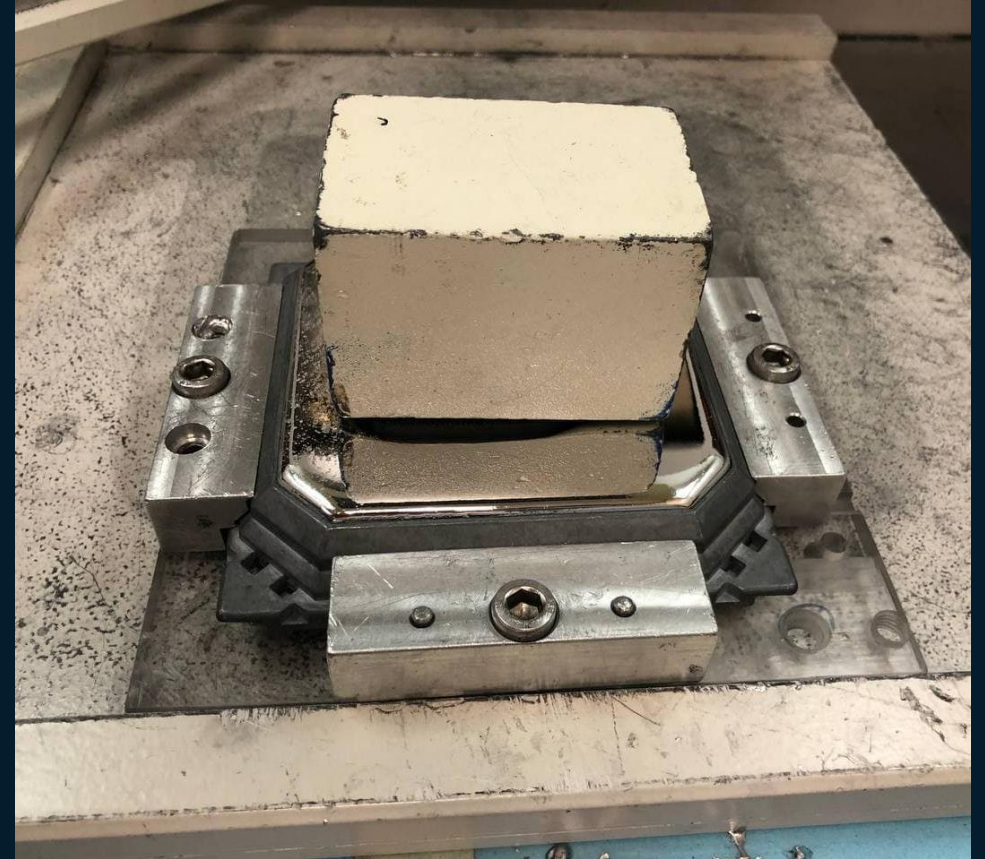
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- Electron plaques are commonly used in radiotherapy for shielding and shaping electron radiation beams.
  - Fabricated by pouring molten Cerrobend in a precise cut-out Styrofoam from a computer cutter.
  - Cost of Styrofoam and maintenance of the system can be high. Significant man-hours are required to perfect the shape of the electron plaque by filing off the excessive regions upon hardening of the Cerrobend.
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# Objective

- Establish a workflow of using a 3D printed mould for the fabrication of electron plaque
- Electron plaque designs in the treatment planning system are drawn using AutoCAD software to be converted to 3D printing file
- AutoCAD software and 3D printing give the flexibility to modify the mould easily such that the outcome of the electron plaque requires minimal or no post-processing needed as compared to using Styrofoam.



# Innovation at its best

## Additive Manufacturing Technology

- 3D Printing to produce electron plaques for electron beam therapy
- Cheaper to maintain and procure as compared to using Styrofoam
- Reduce workflow and cost needed for the process

## Defining Tomorrow Medicine

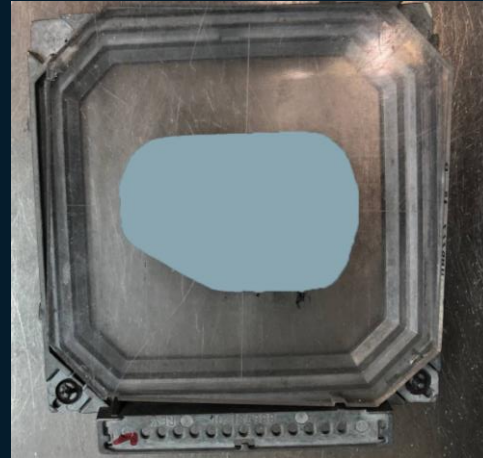
- Further ideas can be expanded with 3D Printing
- Bolus Fabrication
- Immobilization Devices
- Phantoms for 3D Dosimetry in Patient-Specific Quality Assurance



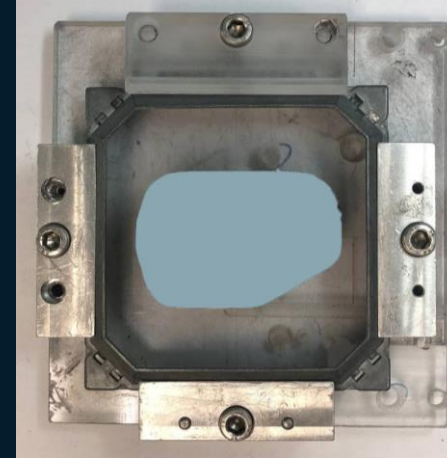
# Current Practice



- Shape of electron plaque is cut out from a piece of Styrofoam using a Computer Cutter



- The blue block is the Styrofoam mould that would be used to mount onto the acrylic plate.

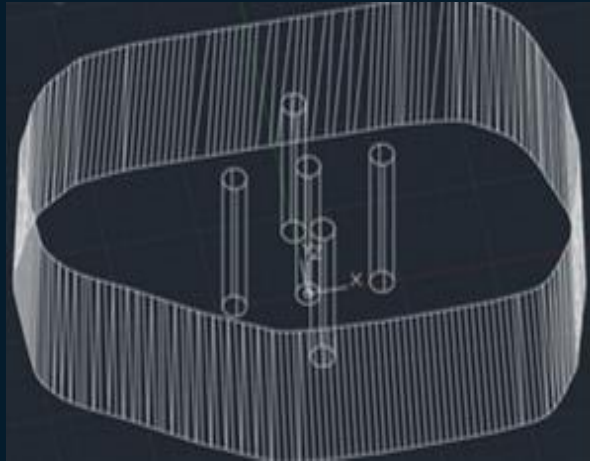


- Cerrobend is poured into the empty spaces and left to harden.

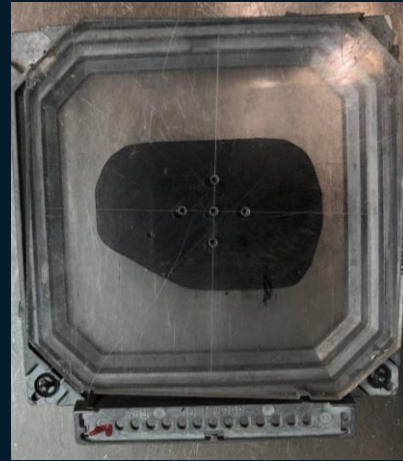


- When the Cerrobend hardened, the Styrofoam mould is removed.

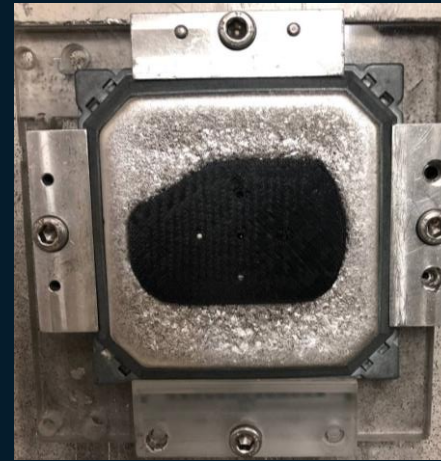
# State-of-the-art Practice



- AutoCAD drawing of electron plaque to be 3D printed used to mount onto the acrylic plate as the mould.



- The black block is the 3D printed mould that would be used to mount onto the acrylic plate.

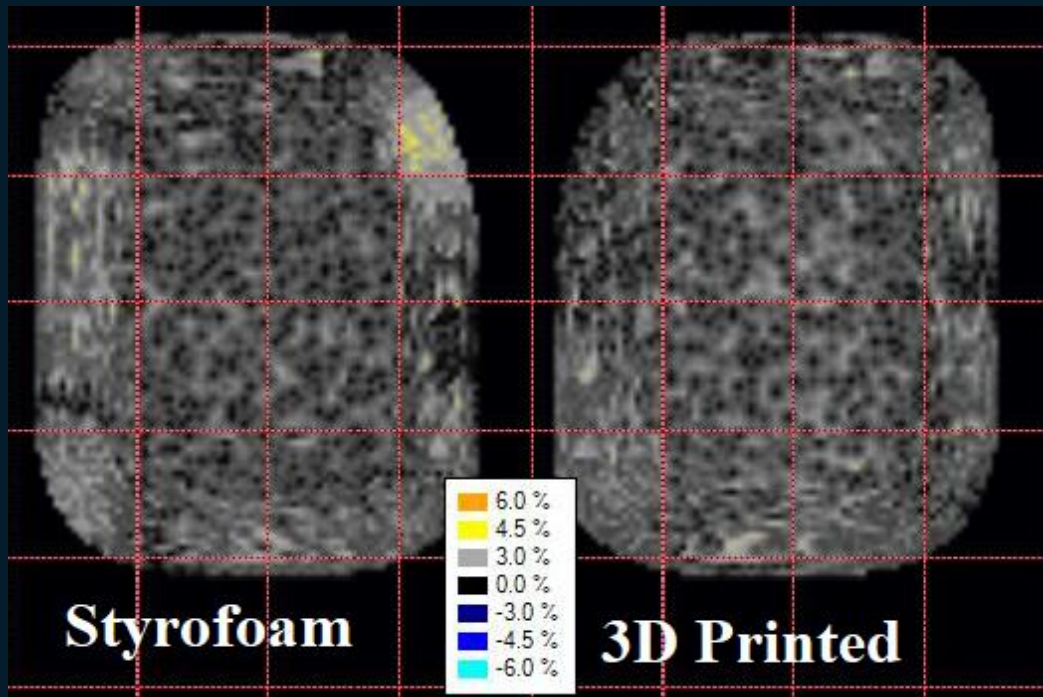


- Cerrobend is poured into the empty spaces and left to harden.



- When the Cerrobend hardened, the 3D printed mould is removed.

# Dosimetric Comparison



- No significant dosimetric differences ( $p > 0.05$ ) in both fabrication processes
- Both fabrication methods are clinically deliverable

Gamma Analysis	2%/2mm	3%/3mm
3D Printed	85.5%	99.5%
Styrofoam Cut	84%	98.6%

# Immediate and Long-Term Positive Impacts



## Optimizing Manpower Requirements

- Reduce man-hour needed for post-processing of the electron plaque



## Reducing Healthcare cost

- Cost of 3D printer, inclusive of maintenance, is 50x less than that of a computer cutter

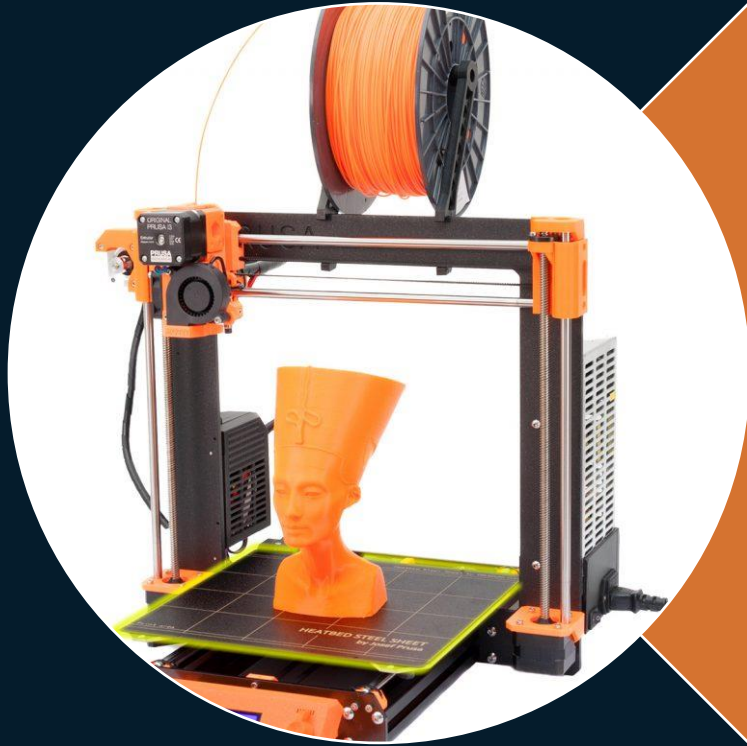


## Environmentally Friendly

- 3D printing plastics can be recycled more readily than Styrofoam. Fumes, a toxic byproduct from cutting Styrofoam, can now be eliminated



# Impact to Institution



By introducing this advanced technology into radiotherapy treatment, innovation to improve the treatment process and reducing the cost would greatly benefit and define Tomorrow's Medicine. People have the freedom to design and implement 3D printing into the treatment workflow with the vast options of materials and dynamic characteristics of 3D printing.

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# Future Possibilities and Challenges

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Singapore Environment Council – A Position Paper

- Singapore plastic waste stream should be directed towards recycling for 3D printing
- Create demand for recycled plastics within Singapore
- Reduce virgin plastics used
- Contribute to the development of the biomedicine industry in Singapore.

With the right resources and recycling procedures, it may be possible in the long run to establish recycling these plastics back into 3D printing material to be used again