A Novel design of artificial limb fabrication using upcyleable composites

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What are the challenges?

79% of plastic waste is disposed of into landfills and the ocean, while only 9% is recycled, and 12% gets incinerated.

Diabetes mellitus will be the leading cause of amputation: 500 M people estimated by 2035.

Statistical Information

- Globally, 100 M people need Prosthetic and Orthotic (P&O) devices.
- 80-90% amputees do have access to P&O devices.

Unmet need:

- Cost
- Comfort
- Time
- Adaptability
- Inclusive Manufacturing
- Locally available material

Objective:

Identify research gaps, co-create new insights into the fabrication of customised prosthetic socket which are accessible, comfortable, able to accommodate aging (crucial for limb deficient child) and minimise perspiration discomfort.

How are we addressing the Unmet Needs?

Test socket manufacturing and testing

- Developed protocol to upcycled domestic plastic waste.
- Established manufacturing techniques for rapid production of test socket using Infra-Red (IR) curing and reusable vacuum bags.
- Evaluation of test socket strength as per the International Organization for Standardization (ISO 10328).

What have we achieved?

- Clinical trials with 53 amputees for clinical evaluation.
- Manufacturing of definitive PET socket for clinical evaluation.
- Clinical trials with 53 amputees over 6 months.

Patient feedback on PET socket

- I am a hotel receptionist and I have lost my legs before 22 years on a train accident. The PET socket provides me the natural walking without any pain.
- I could use this socket for a long time without any sweating.

Unilateral amputee

Bilateral amputee

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Project outcome

The study developed a protocol to engineer upcycled plastic composite to high performance prosthetic sockets having

- Low-cost
- Aesthetic
- Fully recyclable
- Ecological
- Light-weight
- Material availability
- Perspiration comfort
- Thermal controlled retrofit

Fig. 1. Effect of thickness on maximum strength of the Polyactic acid (PLA) and Polyethylene terephthalate (PET) test sockets