

Introduction



Roughly, 178 million people globally, and 6 million people in the US sustain new bone fractures each year. If left untreated, other long-term complications may arise. Traditional casting methods take patients 4-12 weeks on average to heal.

These casts are inconvenient, bulky, uncomfortable, not waterproof, unventilated, and nonadjustable. They also do not incorporate a healing technology. Not to mention the several complications that might arise from their use.



Our device Osteofast is a 3-D printed cast capable of transdermal drug delivery through iontophoresis and electrical stimulation which allows the bones to heal faster by 50-60% compared to traditional casts

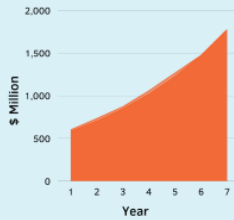
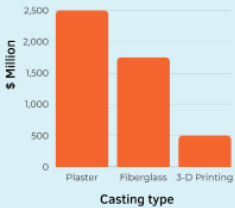
Need Statement

To develop a method to speed up fracture union in patients with closed fractures

Market Analysis

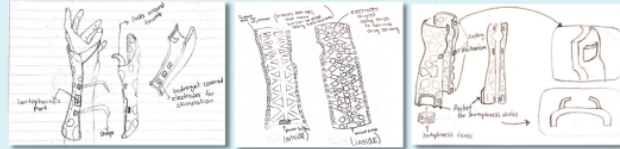
The most common casts products on the market are plaster casts and fiberglass casts.
-Fiberglass cast market size is estimated to be \$1.73 billion in 2020.
-Plaster cast market size: is estimated to be of \$2.4 billion in 2021.

3D printed casts have an estimated current market value of \$589.34 million and is expected to expand by a 20.28% CAGR for 2026
The market value for casts and splinting is predicted to expand up to \$3.1 billion by 2027



Design Concepts

Preliminary Design Sketches



Preliminary Design CAD Models



Final Design

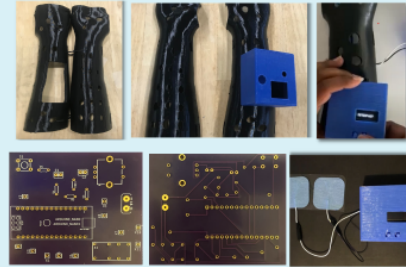
The layout of the design consists of 4 parts. Shell 1 includes hole that can fit the iontophoresis monitor. The iontophoresis monitor will be attached to the iontophoresis transdermal patch via notches. The transdermal patch will be on the patient's skin. The two rigid cast shells will enclose the patient's fractured limb and will be connected to each other using straps. The two rigid cast shells will be designed, and custom fitted to properly immobilize the fractured area of the patient.



 <p>3D printed cast made out of recyclable ABS plastic. Waterproof, breathable, biocompatible lightweight, adjustable, custom-made cast made for user comfort.</p>	 <p>Electrical Stimulation Electrical stimulation stimulates bone formation by enhancing osteoblast synthesis.</p>	 <p>Transdermal Drug Delivery With the help of electric current, bone enhancing drugs can be delivered through the skin for efficient fracture healing.</p>
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Prototype

The casts are custom fitted to the patient's fractured limb. Our prototype cast is modeled after a 3D scan of our team member's right forearm. The thickness of the 2 cast parts are 4mm. The earlier prototypes have been 3D printed with PLA at a 10% infill. The final prototype cast is to be 3D printed with ABS



Prototype Testing

To ensure the device meets all requirements outlined by the FDA, future work on this project would include conducting the required :

- benchmarking tests
- biocompatibility tests
- functionality tests

Conclusion

This device will improve quality of life by providing an alternative to other orthopedic casts that are not waterproof, adjustable, or lightweight, and do not provide healing technology. Osteofast will not only decrease fracture healing time, but also help patients with several underlying medical conditions, like diabetes and osteoporosis, to heal bone fractures without the help of oral drugs or medical intervention. Osteofast will also improve the quality of life of people with busy or physical professions like athletes, firefighters, and labor workers by shortening healing time, which means they no longer need to take long breaks after having bone fractures.