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[ijirset@gmail.com](mailto:ijirset@gmail.com)

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# Modeling and Development of 3D Bone Cast Immobilization

Harikanth S<sup>1</sup>, Vignesh<sup>2</sup>, Suvin S<sup>2</sup>, Swasthik<sup>2</sup>, Sheik Muhammed Anas<sup>2</sup>

Assistant Professor, Dept. of Mechanical Engineering, Yenepoya Institute of Technology, Moodbidri, India.<sup>1</sup>

Students, Dept. of Mechanical Engineering, Yenepoya Institute of Technology, Moodbidri, India<sup>2</sup>

**ABSTRACT:** There are various management-related issues with forearm fractures. Anatomical reduction and immobility are crucial for restoring its function. Traditional casts are unsatisfactory because they are cumbersome, inadequately ventilated, and frequently lead to problems from fractures. The research discusses the use of 3D printing to create an appropriate cast for forearm rehabilitation. New 3D printed casts are significantly better than traditional orthopaedic casts in that they are lightweight, ventilated, custom-fit, strong, and waterproof. It is anticipated that the cost of fabrication and its manufacturing time would be significantly lowered in the future due to technological advancement.

**KEYWORDS:** 3D Printing, Casting, Fracture care, Custom 3D Cast, Additive Manufacturing.

## I. INTRODUCTION

A physical three-dimensional object is produced using the manufacturing process known as three-dimensional printing by adding material layer by layer. For the goals of prototyping and product realisation, this manufacturing technology had mostly been used in the academic and commercial sectors. But more recently, a surge in inexpensive printers has hit the home consumer market, making this capability accessible to more people. More lately, 3D printing has drawn a lot of interest from the therapeutic community, where it may be used to manufacture a variety of patient-specific implantable technologies, splints/casts, and resection guides in addition to its synergistic usage with medical imaging data. Clinical applications of 3D printing have been centred on using it to replace missing bones; In the general population, distal radius fractures are frequent. Plaster casts, splints, and synthetic material casts are used in fracture care to immobilise the damaged arm. These traditional casting techniques frequently have casting issues. In rehabilitation, 3D printing technology is being used more and more. The use of a 3D-printed orthopaedic cast for the treatment of bone fractures has not been the subject of any clinical research, though. We have created a 3D printing-based patient-specific casting technique. This innovative study uses 3D-printed casts we created for the treatment of distal radius fractures in order to undertake clinical evaluations and lay the groundwork for future clinical trials. The technique of layer-by-layer object creation is known as additive manufacturing, sometimes known as three-dimensional (3D) printing.

For centuries, injuries have been immobilized in similar ways. Plaster or, more recently, fibre-glass casts have been used to immobilize the ill and injured limbs. Plaster of Paris has been de-scribed as a method of immobilization since the 10th century by Arabic scientists. Waterproof options, breathability, skin pressure tolerance, and weight of cast wear have yet to be fully addressed. New developments of 3dimensional (3D) technologies offer multiple possible new frontiers to improve patient care and satisfaction, and offer potential comfort as new materials are used in devices patients wear. Benefits of 3D orthosis fabrication include custom fit, breathability, and affordable material. The orthosis can also be designed to accommodate customization such as openings over wounds and injured areas. Furthermore, the innovative construction and simple uniform de-sign allows for waterproof, washable, and dirt- and sand-proof immobilization. 3D printing technology is a rapid growing manufacture technique for producing a complex physical model in term of 3D a digitizing model. It recently has been extensively applying on surgical practices and medical training. The rapid manufacture of the physical model from medical images provides technical means with minimal invasion for medical planning and treatment.



## **II. RELATED WORK**

Reported Casting is a routine procedure used for fracture care in the paediatric population. The purpose of this review is to provide pearls and pitfalls that our institution has learned from previous literature. When applying the cast, we recommend using cotton padding for the liner and fibre glass or plaster depending on how much swelling is expected by Shawn Nguyen et.al. [1]. Concluded that Two-point four out of 100 people suffer from one or more fractures during average lifetimes. Traditional casts are featured as cumbersome structures that result in high risk of cutaneous complications. Clinical demands for developing a hygienic cast have gotten more and more attention by Defeng Wang et.al. [2]. Studied, for centuries, injuries have been immobilized in similar ways. Plaster or, more recently, fibre glass casts have been used to immobilize the ill and injured limbs by Jack Graham et.al. [3]. 3D printing is an evolving technology which has a potential application in the treatment paediatric forearm fractures. Very little has been published regarding 3D casting in children by Daniel Seigerman et.al. [4]. Obtained Distal radius fracture is common in the general population. Fracture management includes a plaster cast, splint and synthetic material cast to immobilise the injured arm by Yan Jun Chen et.al. [5]. Concluded 3D printing is a manufacturing technique by which the material is added layer by layer to create a physical three-dimensional object. This manufacturing technique had primarily found uses in academic and commercial sectors for prototyping and product realization purposes by Angus P Fitzpatrick et.al. [6]. Studied that Management of bone and joint injuries is commonly done by immobilisation using plaster/fibreglass casts. This study describes design and fabrication of patient specific cast using 3D printing. The 3D printed cast while being patient friendly is superior to earlier casts in healing efficacy and hence redefines the joint immobilisation practice by Tanmay Shah et.al. [7]. Studied Hope is that tissue engineering will provide a solution to meet the growing needs for bone substitutes. Among the potential solutions, three-dimensional (3D) printing is a promising method to fabricate functional bone substitutes especially for treatment of complex and critical-sized bone defects by Reza Misael et.al. [8]. 3DP allows the creation of complex geometrical objects such as human anatomy. 3DP applications in a surgical setting have mainly been described for anatomical models by L Krauela et.al. [9]. studied issues contributing to poor patient compliance for splint wear include poor aesthetics, fit and performance. This paper describes a novel digitised splinting process using 3D printing in an attempt to overcome these issues by Abby M Paterson et.al. [10]. Studied Three-dimensional (3D) printing is a rapidly evolving technology with the potential for significant contributions to surgical practice. There are many current applications for 3D printing technology with future applications being explored. This article reviews the current and future applications of 3D technology in orthopaedic surgery by J.S. Mulford et.al. [11]. The currently used plaster cast for wrist orthotic treatment is relatively heavy, non-removable, and unventilated. Because of this, wearing this cast can generate problems including a variety of skin diseases, pilosis, and joint and ligament injuries by Huhn Kim et.al. [12].

A careful study is made to identify the materials used to make our products appropriate into the costs we estimate. The material that we identify is affordable with the cost we spend. The connection should utilize minimal effort materials and assembling techniques. It is easy to fabricate work, keep up and fix.

## **III. METHODOLOGY**

The flowchart of the process for the success of this project. In addition, there are also several steps to be taken as well should be followed in implementing this project. The step is as shown in figure. From the charts of this flow, the activity record for the success of this project can be done smoothly and consistently.



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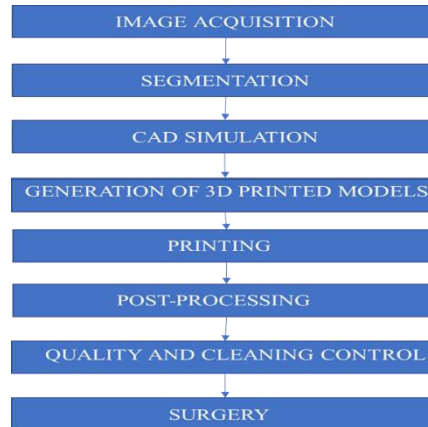


Fig. 1. Flow Chart

#### IV. EXPERIMENTAL RESULTS



#### V. CONCLUSION

The design and fabrication of 3D bone cast immobilization present a promising alternative to traditional plaster casts. 3D printing technology allows for customized and precise casting that can improve patient comfort, reduce complications, and enable quicker healing times. The design process should involve careful consideration of the patient's anatomy, injury severity, and immobilization needs. The use of specialized software and 3D scanning technology can aid in creating a precise digital model of the affected area. During fabrication, the choice of material is crucial to ensure proper support and immobilization while still allowing for ventilation and hygiene. The use of lightweight and breathable materials, such as thermoplastics, can also help to reduce discomfort and skin irritation. Finally, close collaboration between medical professionals, 3D printing experts, and patients can help to ensure the success of the 3D bone cast immobilization process. With proper design and fabrication, 3D bones casts have the potential to significantly improve patient outcomes and revolutionize the field of orthopaedic immobilization.

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