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Design and Manufacturing of Catheter Protector Device

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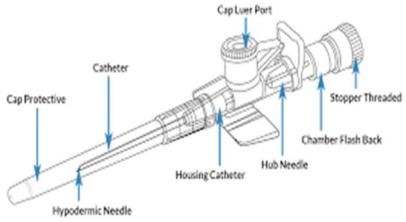
Abstract: ***As the biomedical technology is growing with technology, they became significant importance in healthcare as they enable diagnosis, treatment, monitoring, ultimately improving patient outcomes and enhancing the quality of healthcare. The project is mainly based on medical device called catheter protector, it is creating a protector for catheter which is used when the catheter breaks out or gets ruptured and understand the purpose and importance of various experiments and testing methods in medical field. In catheter protector, depending on the size of the internal diameter of catheter, the protector gets aligned with the cannula and protects from the breakage and outrage of the needle.***

In an optimal scenario, the model works comfortably with the different ages of people. The project discusses various techniques and methods used during the process of modelling and testing. By considering the research of relevant projects, there is need to develop a efficient solution consisting of the problem of breaking and rupture of cannula in patients. In future the protector is going to play a vital role in controlling and functioning of cannula needle and helps in increasing effectiveness and performance of the needle with the protector.

Keywords*: catheter, testing, needle, rupture, protector.*

I. INTRODUCTION



Biomedical devices are various medical devices, machines, devices or facilities designed to diagnose, treat, monitor or control diseases in humans. These devices are used in many healthcare settings, including hospitals, clinics, and home care, where they play an important role in improving patient care and outcomes.

A catheter is a flexible tube used to inspect and lcontrol various parts of the body such as urine**,** blood vessels or other organs. Cathe terization is the process of inserting a catheter into the body to perform certain medical procedures or manage conditions**.**

Catheterization is usually performed in a clinical setting by a medical professional, such as a physician, nurse,or physician trained to established proceduresand guidelines.

A catheter is a special medical device used to access and manipulate parts of body in many medical procedures. The main functions of catheter are, they generally used to insert into body cavities, blood vessels or organs for various purpose such as medication, fluid removal, drainage or body care. In medical, there is a thin flexible tube made from medical grade materials serving a broad range of functions. Catheters are medical devices that can be inserted in the body to treat diseases and perform a surgical procedure. A catheter left inside body, either temporarily or permanently, may be referred to as an “indwelling catheter”.

Catheters can be inserted into a body cavity, duct or vessel, skin or tissue. Functionally, they allow drainage, administration of fluids or gases, and also perform wide variety of other tasks. The main purpose of the project is to highlight on the consequences faced due to breakage of the catheter and create solution for the catheter to prevent rupturing. When people face this situation, they have to go through harsh pain and patient becomes sicker due to it. The protecting cover handles these sensitive issues with more care.

The actual reason to select the project based on medical instrument is to imply and improve the knowledge of modelling to execute in welfare of people and problem solving technique which helps to reduce complications and troubles faced by patients.

The catheter protector device is further used to demonstrate the performance in real time hospitals. The trials will provide the flaws which are being occurred during the process of installing catheter protector on arm. Based on the results summarised, further upgrade and correction can be made according to the feedback received from patients and doctors

II. LITERATURE REVIEW

Linshuai Zhang & Shuxiang Guo & Huadong Yu & Yu Song & Takashi Tamiya & Hideyuki Hirata & Hidenori Ishihara [1], stated the study of the complications of peripheral intravenous catheters in the hand and forearm. The most common sites for developing complications of frequency were the forearm, hand, wrist. The frequent and normal complications faced were blood infections, damage of catheter due to movement which caused severe infections and injury to the patients. Along with the rapid development of the medical technologies, catheter needle protector device is an effective treatment method applied to treat these rupturing phenomena. Continuous research delivered the work to breakdown and understand the typical feature of catheter working and its drawbacks related to its misalignment and disengaging. To solve these disadvantages, the research and survey information has helped to deviate work towards protector of catheter.

F. Ahmadkhanlou, G.N.Washington, S.E. Bechtel [2],in the paper stated that the catheter protector protects the needle of catheter during insertion and thus by preventing outbreak of cannula tube and stabilizing the motion of hands. However, few designs have considered during initial stage of modelling of protector.

This review presents a novel catheter protector system based on protection of needle getting misaligned due to sudden movements. The integrated model of catheter protector not only reliefs the pain due to insertion, but also allows free motion of hands due to outer protector.

The clips of catheter protector holds the wing of cannula which avoids the angular movements of catheter and holds stir. A significant advantage is that the proposed model can be used as a safety device for sensitive care patients (pregnant womens, infants, old age peoples) with the least effort.

To verify the effectiveness and of catheter protection device, the evaluation surveys and consultations were carried out. The results and suggestions from doctors show that further catheter needle rupturing can be effectively prevented by using catheter protector, which implies the safety of patients during catherization. This projects research provides some insights into the functional improvements of safe and reliable catheter protector device.

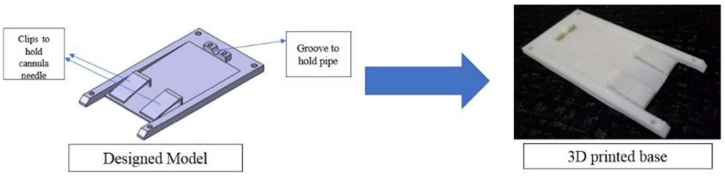
Mermel LA [3][6], studied a report from the American Heart Association (AHA) showed that: cardiovascular and cerebrovascular diseases have become one of the three major causes (heart disease, stroke and vascular diseases) of death in human beings, which is a serious threat to human health (Lloyd-Jones et al. 2010). The robot-assisted catheter system was introduced that can increase operating distance thus preventing the exposure radiation of the surgeon to X-ray for endovascular catheterization. Significant advantage is that the proposed mechanism can adjust the protection threshold in real time by the current according to the actual characteristics of the blood vessel. The results show that the further collision damage can be effectively prevented by the CPM, which implies the realization of relative safe catheterization.

STEVEN W. MERRELL, MD; BONNIE G. PEATROSS, RN, MS; MICHAEL D. GROSSMAN, MD; JOHN J. SULLIVAN [4] [5], evaluated about maintaining reliable vascular access in patients hospitalized long term can be difficult for both patients and their physicians. Many techniques have been developed for this purpose, including peripheral venous cannulas, arteriovenous fistulas, percutaneous central venous catheters, subcutaneously tunneled right atrial catheters, and peripherally inserted central venous catheters. Peripheral venous cannulas must be changed frequently, and access sites may be rapidly exhausted. Arteriovenous fistulas require an operative procedure, and the rate of complications has been unacceptably high when compared with other alternatives.' Percutaneous central venous catheters are uncomfortable, carry substantial risks associated with insertion, and usually require that patients are kept in the hospital during their use.

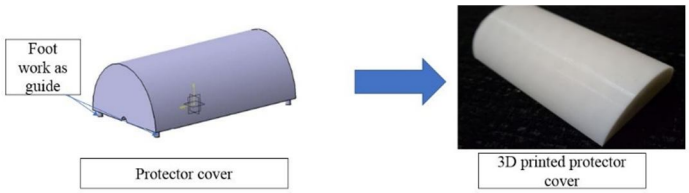
Tunneled catheters carry similar risks and also require surgical insertion.3 A useful alternative is the peripherally inserted central venous catheter (PICC), which was introduced in 1975.5 This silastic catheter is inserted into a peripheral arm vein and passed centrally into the superior vena cava. The use of these catheters has gained wide acceptance for patients undergoing long-term cancer chemotherapy total parenteral nutrition

(TPN), and antibiotic therapy.Peripherally inserted central venous catheters can be inserted at a patient's bedside or in an outpatient clinic and are immediately available for use once correct placement is confirmed. These catheters appear to be less thrombogenic than Teflon and polyethylene catheters, and their pliability helps ensure patient comfort.20'2 Complications have generally been benign and can usually be treated without removing the catheter.

III. DESIGN AND WORK PROCEDURE



1) It consists of clips, pad, needle, holder, four socket and a belt.
2) Clips are used to hold the wings of cannula which is the main purpose of protector.
3) Pad is base of cannula for protector and clips on which needle holder is mounted.
4) Four sockets are used to fix the cannula cover.
5) The socket at rear will fix the tube securing it by a zip tie.
6) Belt is used to hold the protector on hand and it reduce the motion due to action of hand, it is made of up of soft Velcro material.



a) The cover is used to protect the protector of cannula.
b) It is made up of polypropene which is biomedical plastic material suitable for making biomedical instrument and equipment.
c) It helps the patient to get comfortable while sleeping (resting) avoiding direct contact with the cannula needle.
d) It is coated with soft touch material to make patient more comfortable.
e) The arc of cannula cover protects the Injection Port Cap and wings of cannula.

IV. PATENT WORK

Our product is in currently obtaining a patent, demonstrating our commitment to protecting our unique technology. Our biomedical catheter protectordevices are now rigorously tested and evaluated in clinical trials to ensure they are safe and effective**.** We are committed to extensive and practicaltesting to provide you with quality products that meet the highest standards of performance and patient care.

V. ADVANTAGES

1) For mentally challenged infants and pregnant women's, the needle protector plays crucial role in maintaining the cannula stable.
2) It eliminates the complications when cannula needle is taken out.
3) It brings advancement in medical facility making available for large number of patients.
4) The development of a sensitive care model which holds the needle structure, assist in patients movement actions.

VI. CONCLUSIONS

As the device is covered with all modelling and simulation part with the prototype being made physically with the 3D printer, to solve the real time medical related difficulties with the less cost budgeting and more performing power and to control the situation with the device being used. This catheter protector device represents a significant advancement in the field of biomedical devices. With its innovative design and superior functionality, it addresses the critical need for improved catheter protection and patient comfort. Our device is going under extensive testing and validation to ensure its effectiveness and safety, and we are in the process of obtaining a patent to protect our unique technology.

VII. ACKNOWLEDGEMENT

We would like to express our heartfelt gratitude to our Principal Dr. V. A. Athavale and Head of Department Dr. B.B. Deshmukh for letting us to work on this project.

Furthermore, we would like to acknowledge our guide Mr. D. D. Maslekar for giving us valuable support and guidance to deal with difficult process while going through project, which made us think in different angles to work out the device.

We are truly grateful for the collective efforts of all those who connected with this project and have contributed to the publication of our research paper. Thank you for your invaluable support, and we look forward to continuing our research endeavors in the future protection and patient comfort. Our device is going

under extensive testing and validation to ensure its effectiveness and safety, and we are in the process of obtaining a patent to protect our unique technology.

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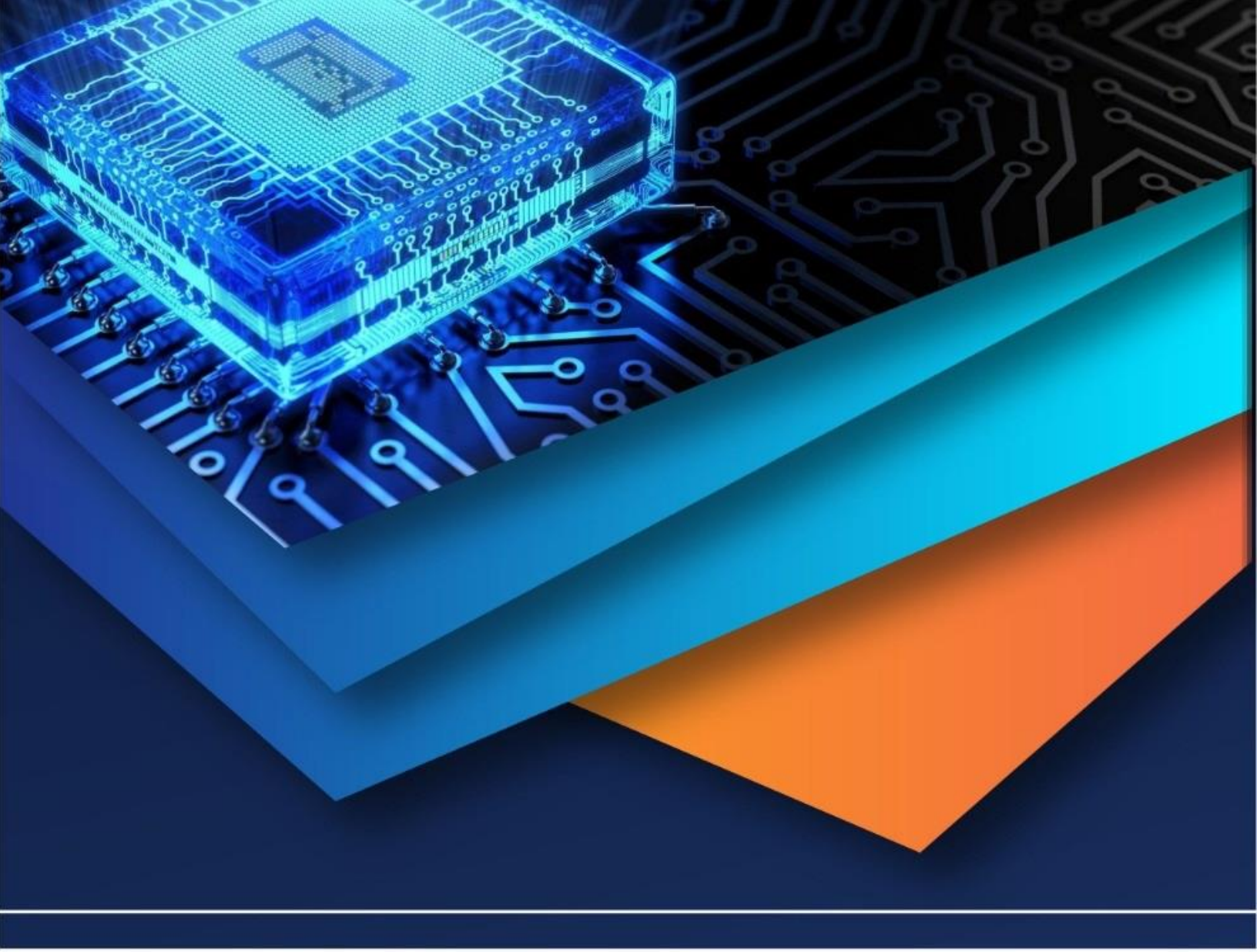

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