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DESIGN OF OPHTHALMOLOGY TOOL USING ADDITIVE MANUFACTURING

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ABSTRACT

The technique of additive manufacturing is applied in a variety of industries. In this technique, numerous knives, speculum, and corneal transplant trephines blades-keratoplasty and donor punch are selected from the ophthalmology area of surgical equipment. In order to do the procedure, we must utilize a large number of knives, each of which must be replaced one by one, with no two knives performing the same task. It is said to be inefficient. To get around this, we may utilize a multi-knife with a single handle, which is more cost effective. It'll save you time and effort in the long run. As a result, if you use a multi-knife, your knife will be less expensive and of better quality. It will minimize biowaste and save us money.

Keywords : multiknife, biowaste, knife, donor punch

1. INTRODUCTION

As contrast to subtractive manufacturing, materials are used to manufacture products from 3D model data, generally layer by layer. Design and modelling, fit and function prototype, and direct component manufacturing are the main uses of additive fabrication. Design, prototyping, and production time have all been reduced thanks to additive manufacturing, which has also reduced expensive mistakes and improved product quality. The discipline of ophthalmology is the branch of medicine that deals with eye problems and their treatment. The term "ophthalmology" literally means "eye science." It is a discipline that deals with animal eyes. Furthermore, the deviations from human practise are surprisingly minimal, and are mostly due to changes in anatomy or prevalence, rather than disease processes. Surgical knife, speculum, cornea translate-keratoplasty, and donor punch are the most common tools used in ophthalmology. The main issue we're working on is a design and analysis solution for additive manufacturing technology. Ophthalmology surgery employs a variety of knife angles.

Feather's patented ultra-high-precision honing process is used to make the Micro feather ophthalmic micro knife out of the best grade stainless steel. The ultra-sharp blade edges created by a twofold honing process from carefully selected materials offer a sharp cutting edge with exceptional durability. In addition to avoiding tissue damage during incisions, the knife's constant cutting quality allows for precise incision sizes at all times, making it the perfect ophthalmic micro knife from Feather, Japan's most prestigious blade maker. The straight, ultra-sharp blade of the incision knife is properly polished in nano units for maximum usage in semi-laminar incisions and contests sclera and corneal incisions.

2. LITERATURE SURVEY

Massimo Busin, M D microkeratome et al., [1] modified assisted lamellar keratoplasty for the treatment of keratoconus (exchange of a 9.0-mm anterior recipient lamella with a 9.0-mm donor lamella, using a 200-m head for the former and a 300-m head for the latter) by adding a 6.5-mm incomplete full-thickness incision in the recipient bed before suturing The

donor lamella was perforated to a size of 9 mm. The cornea was then punctured using a 6.5-mm Barron trephine (Katena Products Inc) focused on the pupil.

Kyle Thistle (Kyle Thistle) [2] the following are examples of how this feature of the invention has been implemented: The diameter of the second circle is in the range of 6 mm to 8 mm, while the diameter of the first circle is in the range of 8 mm to 10 mm.

ErumShahid and ArshadShaikh [3] used two distinct types of eye speculums to measure the difference in intraocular pressure. From November 2011 to May 2012, the research was carried out at Karachi's Abbasi Shaheed Hospital's Department of Ophthalmology. A hundred patients were randomly selected and divided into two equal groups using probability convenience sampling.

The following define the incidence and types of intraoperative flap complication in laser in situ keratomileusis, according to SalehA.Al- Amro [4].

To find the aetiology of ocular surface foreign bodies and their correlation with placement in the eye, Ahmad ZeeshamJamil [5] forms of ocular surface foreign bodies and their linkage with location in the eye.

The optical control of sharp ophthalmic instruments by J.F. Kayser and John Foster [6] evaluate the difference sharpness of a cataract knife by its surgical performance, allowing for changes in scleral toughness and sterilising effects.

Thomas C. Smith [7] Materials such as stainless steel, sapphire, ruby, cubic zirconia, pure or composite ceramics, and stainless steel, sapphire, ruby, cubic zirconia, pure or composite ceramics can be substituted for diamond in ophthalmology surgical blades.

Alexander M. Easton's [8] ophthalmic surgery instrumentation and method of application was hemo tissuses neighbouring tunnel-wall tissue, thereby exposing the sharp point only after it had been securely exposed.

2.1 PROBLEM IDENTIFICATION

The primary challenges in ophthalmology surgical knives are caused by the,

1. The modern material surgical knife is more expensive, but it can be used as a disposable in the hospital.
2. After autoclaving, the stainless steel surgical knife is prone to corrosion.
3. During surgery, it may become easily flexible (Titanium).
4. Polycarbonate disposables harm the environment.
5. Changing surgeries during surgery may result in more time being consumed.

2.2 OBJECTIVE

This project's goal is to present four different design options, with the single lock re-usable handle design being the most popular. The design includes an analysis and fabrication of a single lock reusable handle model in additive manufacturing technology, which is printed in a 3D printer. An ophthalmic specialist surveyed the three-dimensional model. To build the final component, the ophthalmologist's feedback is used [9].

3. DEVELOPMENT IN DESIGN OF OPHTHALMOLOGY TOOL USING ADDITIVE MANUFACTURING

The first portion of this lock handle is the slider, while the second section is the cover for the slider. This component was made with Solidworks 2014 programme. The slider is 80mm in length and 3mm in diameter. The length of the head is 20mm. The diameter is 3mm if you slant it 45 degrees at 10mm. The slider is a 5mm high, 5mm long, and 2mm wide extruded button lock that is used in the middle of the handle. The revolving cut mid plane is 80mm long, and the slider cover is 100mm long. In terms of time consumption and handling efficiency, this design is inconvenient for ophthalmologists. As a result, that design will be further improved.

Figure 1 Rack and pinion lock reusable handle model

3.1 DOOR LOCKING SYSTEM HANDLE

This lock handle has two parts: the first is the slider, and the second is the cover for the slider. Solidworks 2014 software was used to create this component. The slider has a length of 80mm and a diameter of 3mm. The head is 20mm in length. And if you slant it 45 degrees at 10mm, the diameter is 3mm. The slider is an extruded button lock with a 5mm height, 5mm length, and 2mm width that is utilised in the centre of the handle. The length of the slider cover is 100mm, and the revolve cut mid plane is 80mm. This design is inconvenient for ophthalmologists in terms of time consumption and handling efficiency. As a result, that design will be developed in the future.

Figure 2 Door locking system handle model

3.2 FIXED MULTI KNIVES

This fixed handle is made out of a single piece, with two

different sorts of blades on each ends. Solidworks 2014 software was used to create this component. The handle is cylindrical and sturdy. Total tool length is 130mm, with a diameter of 5mm. Like the current trend of utilising a surgical knife. The blade has a length of 10mm. This knife is equipped with safety caps. The caps measure 25mm in length, 5mm in diameter on the inside, and 6mm on the outside. The cap grasping for knurling that has been employed. This design is inconvenient for ophthalmologists in terms of time consumption and handling efficiency.

Fig.3. Fixed multi knives model

3.3 SINGLE LOCK REUSABLE HANDLE

Solidworks 2014 software was used to create this component. The entire length of the handle is 100mm, and the diameter of the handle is 5mm. Then there's a 4mm inner diameter. Both ends of the component are extruded hollow for 10mm, and the gripping purpose is to apply knurling on both handle ends. Then, using a keyway lock with a 0.20mm depth cut, cap lock. We use the next head lock for a single lock system with a 1mm height, width, and length of 5mm.

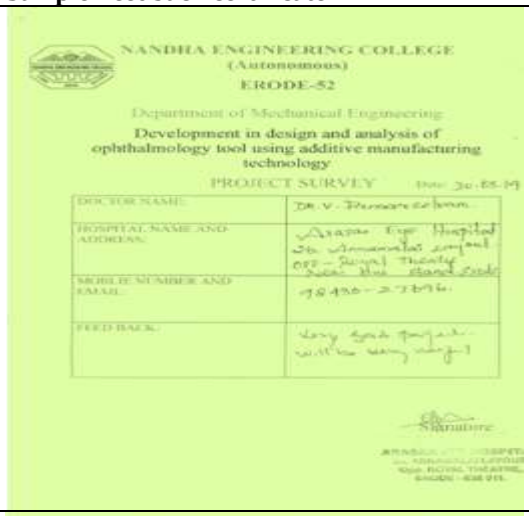
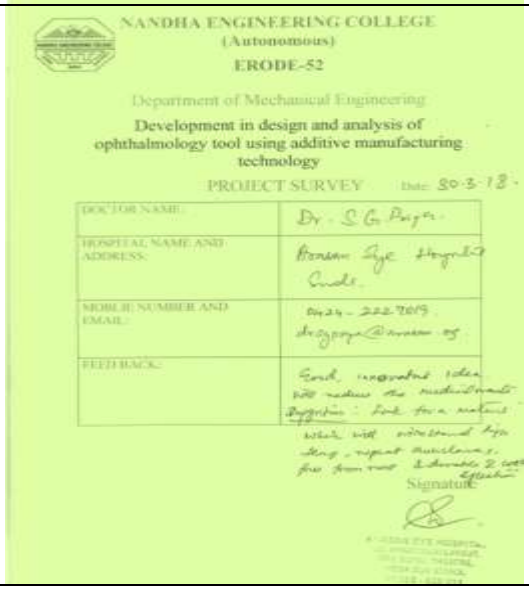
The entire length of the knife head is 25mm. slant it 45 degrees at 10mm, the diameter is 5mm. Injection moulding surgical blade insert has a 2mm hollow gap inside the head. For the head lock system, the extrusion has a length of 15mm and a diameter of 4mm. The extrude section is a 10mm revolve cut with a 45o rotation at 2mm. This design is a success model since it is convenient for ophthalmologists in terms of time consumption and handling economy.

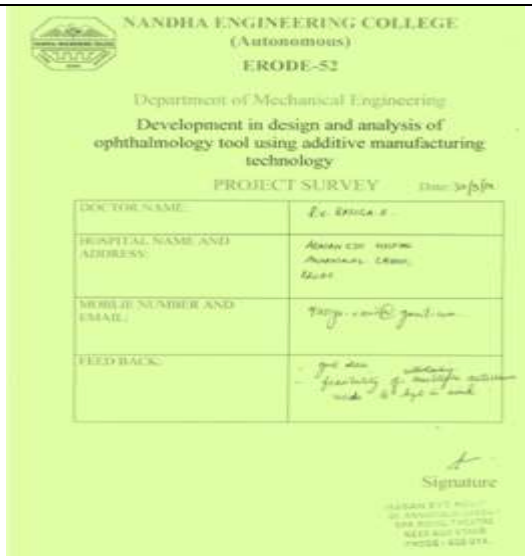
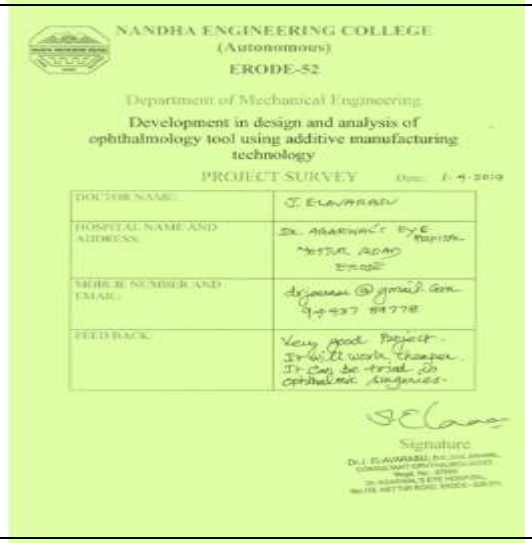
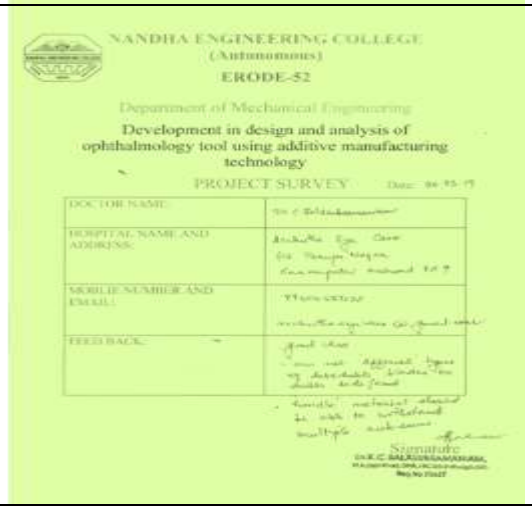
Figure 4 Single lock reusable handle model

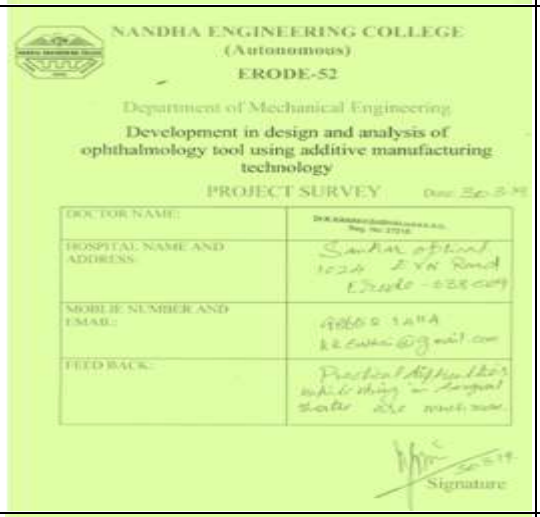
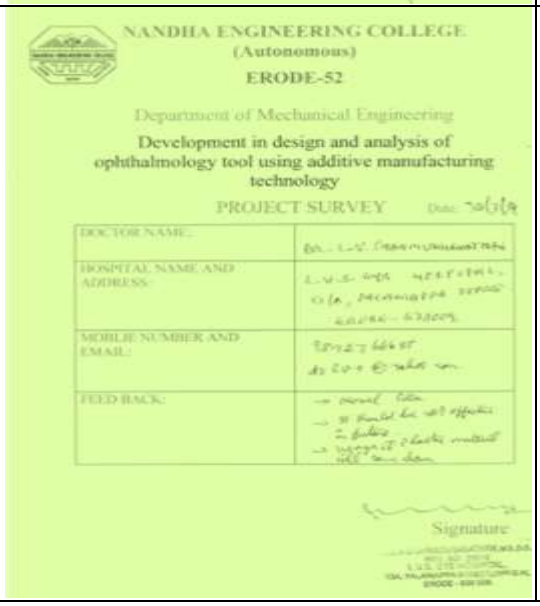
4. PROJECT SURVEY has reviewed by ophthalmologist as follows:

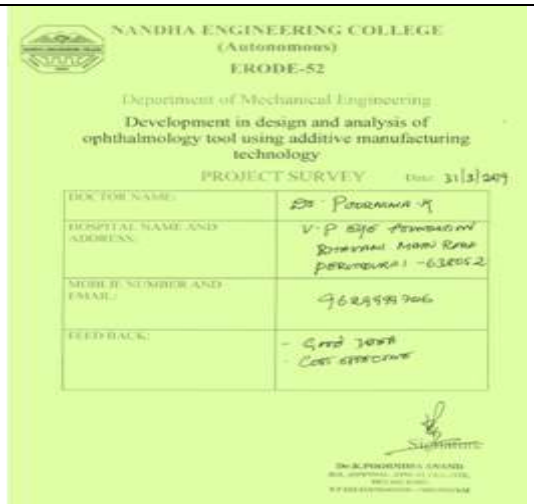
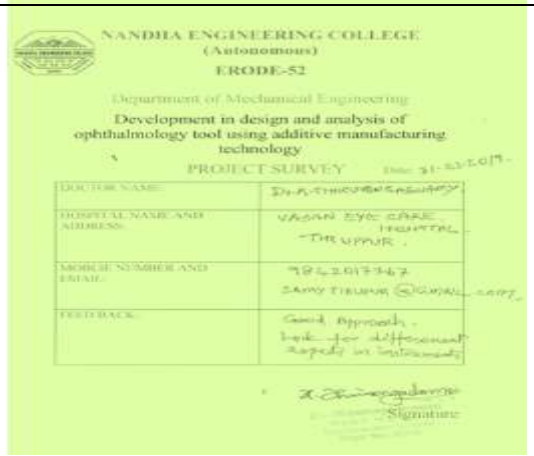
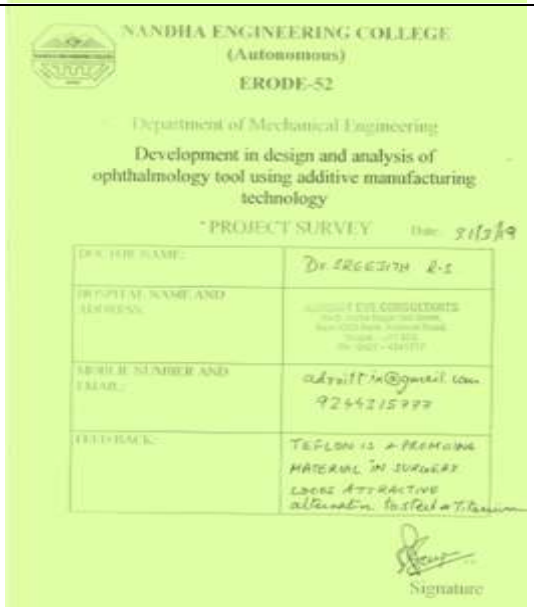
The single lock reusable handle prototype model

Table 1 project survey of ophthalmologist

S. No	Hospital Name	Doctor Name	Sample Feedback certificate	Remark
1	Arasan eye hospital, Erode	Dr. V. Panneerselvan	 NANDHA ENGINEERING COLLEGE (Autonomous) ERODE-52 Department of Mechanical Engineering Development in design and analysis of ophthalmology tool using additive manufacturing technology PROJECT SURVEY Date: 20.03.19 DOCTOR NAME: Dr. V. Panneerselvan HOSPITAL NAME AND ADDRESS: Arasan Eye Hospital 98430-27676 FEED BACK: Very good project will be very useful Signature	Very good project will be very useful
		Dr. S. G. Priya	 NANDHA ENGINEERING COLLEGE (Autonomous) ERODE-52 Department of Mechanical Engineering Development in design and analysis of ophthalmology tool using additive manufacturing technology PROJECT SURVEY Date: 20.3.19 DOCTOR NAME: Dr. S.G. Priya HOSPITAL NAME AND ADDRESS: Aravind Eye Hospital Erode MOBILE NUMBER AND EMAIL: 0424-222 7015 drsgpriya@aravind.org FEED BACK: Good innovative idea will reduce the medical waste Suggestion: Look for a material which will withstand hot sterilizing repeat autoclave for four two Signature	Will reduce the medical waste.

		Dr. R. Rasiga		Feasibility of multiple n autoclaves needs to kept in mind.
2	Dr. Agarwal's eye hospital, Erode	Dr. J. Elavarasu		It can be tired in ophthalmology surgeries.
3	Acchutha eye hospital, Erode	Dr. C. Balasubramaniam		Handle material should be able to withstand multiple autoclaves.

4	Sri Ragavendra eyehospital, Erode	Dr. S.S. Sukumar	 NANDHA ENGINEERING COLLEGE (Autonomous) ERODE-52 Department of Mechanical Engineering Development in design and analysis of ophthalmology tool using additive manufacturing technology PROJECT SURVEY	Look for different aspects in instruments.
5	Sankar optical, Erode	Dr. K. Kanakasabhai	 NANDHA ENGINEERING COLLEGE (Autonomous) ERODE-52 Department of Mechanical Engineering Development in design and analysis of ophthalmology tool using additive manufacturing technology PROJECT SURVEY DOCTOR NAME: HOSPITAL NAME AND ADDRESS: MOBILE NUMBER AND EMAIL: FEED BACK: Signature	Practical difficulties while using in surgical theatre are much more.
6	L.V.S. eye hospital, Erode	Dr. L.V. Shanmuganathan	 NANDHA ENGINEERING COLLEGE (Autonomous) ERODE-52 Department of Mechanical Engineering Development in design and analysis of ophthalmology tool using additive manufacturing technology PROJECT SURVEY DOCTOR NAME: HOSPITAL NAME AND ADDRESS: MOBILE NUMBER AND EMAIL: FEED BACK: Signature	Usage of plastic material will is down.

7	V.P. eye foundation, Perundurai	Dr.K. Poornima	 NANDHA ENGINEERING COLLEGE (Autonomous) ERODE-52 Department of Mechanical Engineering Development in design and analysis of ophthalmology tool using additive manufacturing technology PROJECT SURVEY Date: 31/3/2019 DOCTOR NAME: Dr. POORNIMA K HOSPITAL NAME AND ADDRESS: V.P EYE FOUNDATION RAMAKRISHNA NAGAR ROAD PERUNDURAI - 638052 MOBILE NUMBER AND EMAIL: 9629599706 FEED BACK: - Good Tools - Cost effective Signature	Cost effective.
8	Vasan eye care hospital, Tiruppur	Dr. K. Thiruvengadasamy	 NANDHA ENGINEERING COLLEGE (Autonomous) ERODE-52 Department of Mechanical Engineering Development in design and analysis of ophthalmology tool using additive manufacturing technology PROJECT SURVEY Date: 31-03-2019 DOCTOR NAME: Dr.K.THIRUVENGADASAMY HOSPITAL NAME AND ADDRESS: VASAN EYE CARE HOSPITAL -TIRUPPUR. MOBILE NUMBER AND EMAIL: 9842017367 FEED BACK: Good Approach. Look for different aspects in instruments Signature	Look for different aspects in instruments.
9	Adroitt eye hospital, Tiruppur	Dr.R.S. Sreejith	 NANDHA ENGINEERING COLLEGE (Autonomous) ERODE-52 Department of Mechanical Engineering Development in design and analysis of ophthalmology tool using additive manufacturing technology PROJECT SURVEY Date: 31/3/19 DOCTOR NAME: Dr. SREEJITH R.S HOSPITAL NAME AND ADDRESS: ADROITT EYE CONSULTANTS MOBILE NUMBER AND EMAIL: adroitt.in@gmail.com 9244215777 FEED BACK: TEFLON IS A PROMISING MATERIAL IN SURGERY LOOKS ATTRACTIVE alternative to speed & Titanium Signature	Teflon is promising material in surgery. Looks attractive alternative to speed and titanium.

6. CONCLUSION

[1] Three key kinds of ophthalmic surgical tools that may be designed and analyzed utilizing additive printing technology: speculum, donor punch, and multi-knive.

[2]. Ophthalmic surgeries, multi-knives are indispensable. As a result, we selected multiknive as a tool and put our paper into action.

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