GNG2101

Design Project User and Product Manual

Renal Care Device

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List of Acronyms and Glossary

Table 1. Acronyms

Acronym	Definition
BOM	Bill of Materials
PLA	Polylactic acid
UPM	User and Product Manual

Table 2. Glossary

Term	Acronym	Definition
Osteoarthritis	OA	The most usual form of arthritis. It occurs most frequently in the hands, hips, and knees. The cartilage within a joint begins to break down and the underlying bone begins to change.
Pliers	PL	Pincers with parallel, flat, and typically serrated surfaces, used chiefly for gripping small objects or bending wire.
Renal	RN	Relating to the kidneys

1 Introduction

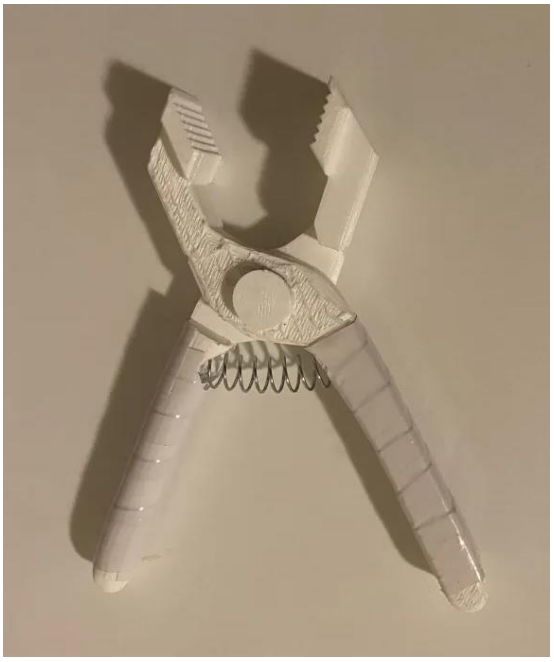
This User and Product Manual (UPM) provides the information necessary for renal nurses to effectively use the ErgoCares Clamp and for prototype documentation. This document will compile our group's process in designing a renal care device that will assist nurses when clipping blood tube clamps.

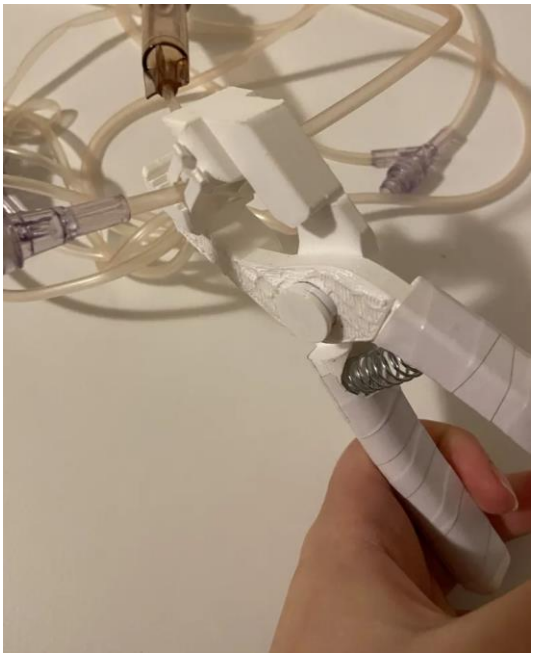
The goal is to reduce the stress on the thumb, and subsequently avoid arthritis in the thumb caused from the clipping motion. The primary audience for this document includes healthcare professionals involved in renal care, particularly those responsible for closing renal clamps. This may include nurses, medical technicians, and other healthcare personnel. It assumes users have a basic understanding of medical procedures involving renal care and are familiar with general medical device handling protocols.

The user manual will have the following structure, an overview, followed by getting started. Information on how to use the system and troubleshooting and support. The document will conclude with product documentation, testing and validation.
While the medical-grade plier is designed with safety in mind, users are advised to ensure compliance with relevant healthcare regulations and protocols when using the plier in a medical setting. This user manual aims to facilitate the effective and safe use of the medical-grade plier, contributing to the overall efficiency and well-being of healthcare professionals in the field of renal care.

Overview

The problem lies in renal care clinics where nurses are developing arthritis in their thumbs due to the repetitive clipping motions of renal clips. This causes the nurses to have pain in their joints which leads to an overall decrease in workplace happiness and productivity. Our users, renal care nurse, need a device which can alleviate this strain on their thumbs while also being maneuverable, easy to clean, user friendly and quickly accessible. Our product solves an issue which no other companies have yet to tackle; regardless, we have created a product that meets all the client's need in a simple yet efficient design. Our specially designed head is created to perfectly fit the standard renal clip and close them with minimal force required from the thumb.





Our pliers were 3D printed using PLA, a durable material that is also lightweight. Key features on our product are the spring, specially designed head, and comfortable handles. The spring allows for quicker and easier clipping, reducing the need to re-open the pliers after closing it. The head is specifically designed to fit most renal clips and also has grooves to increase grippiness when clamping. Lastly, the handles are specially designed to reduce the strain on the thumbs and give nurses a more comfortable and pain free way to do their jobs. A bonus on the handles is a small hole that was designed as an easy way for nurses to attach the pliers to their lanyards.

1.1 Conventions

There are no applicable stylistic and command syntax conventions required in this document.

1.2 Cautions & Warnings

The prototype is 3D printed and can come apart if too much force is put onto it in the wrong direction. Clamping should be done carefully and without excessive aggression. Do not clamp down onto other items as this may break the pliers.

2 Getting started

This next part of the manual will provide a general walkthrough of ErgoCares' Renal Clamp Pliers.

2.1 Configuration Considerations

Our product was designed to be used intuitively. It comes fully assembled and simply requires the user to align the pliers to the clips and squeeze the handles with their whole hand. If desired, the user may attach the pliers to a lanyard through the incorporated hole in the handle.

2.2 User Access Considerations

The prototype will mainly be used by nurses in a clinical/hospital setting. The main accessibility issues would be hospitals providing our pliers to the nurses at a low or no cost. Ideally, the nurses are provided with the product but there may be initial accessibility issues with streamlining the usage.

2.3 Accessing/setting up the System

Our product was designed with accessibility and ease of use kept in mind. There is no setup required nor any adjustments to be made by the users.

2.4 System Organization & Navigation

The pliers have 2 parts, the head/handles, and the spring.

2.4.1 Handles

The two sides of the handles are joined together by a 3D printed fastener in the center. One side of the handle has a hole designed for nurses to connect their lanyard through.

2.4.2 Spring

The handles have a specially designed compartment to hold the spring. The spring is then inserted on both sides and held in place with glue.

2.5 Exiting the System

The product is intended to be kept on the nurse's person. Like an ID badge, the pliers would be kept on a lanyard which the nurses can easily keep pinned to their scrubs.

3 Using the System

The following sub-sections provide detailed, step-by-step instructions on how to use the various functions or features of the ErgoCares Pliers.

3.1 Clamping

The user is required to align the head of the pliers to the renal clamps and simply squeeze the handles. An average amount of force is required and is to be released once the clamp clicks closed. Most importantly, the pliers are to be clamped with the whole hand so as to reduce the force directly put onto the thumb.

https://drive.google.com/file/d/1K6EcG1qkidTFUW6fsiZB1AHHCh8Qn-bf/view?resourcekey

4 Troubleshooting & Support

This comprehensive guide is designed to assist users in addressing common issues with the medical-grade plier while emphasizing safety and simplicity for non-engineers. Always prioritize safety and seek professional assistance when needed.

4.1 Error Messages or Behaviors

General Troubleshooting: If the plier is not functioning correctly, follow these general steps:

Step 1: Inspection: Visually inspect the plier for any visible damage, loose components, or foreign objects.

Step 2: Clear any blockage or debris that may be obstructing the pliers and ensure all components are tightly connected.

Error Condition: The plier fails to close the renal clamp as expected.

Step 1: Ensure proper alignment of the plier jaws with the renal clamp.

Step 2: Check for any obstructions or debris hindering the closing mechanism.

Step 3: If the issue persists, discontinue use and contact customer support.

4.2 Special Considerations

If no solution is found, it is recommended to discard the pliers and use a new pair. These pliers were designed and manufactured with the thought of being readily accessible to nurses and therefore, hospitals are asked to have an overstock of them so they can be replaced if broken.

4.3 Maintenance

Due to the healthcare setting in which our product will be used, adequate sanitation will be required after each patient. Nurses should be regularly cleaning their clamps to avoid cross-contamination between patients. This also ensures that no debris can clog up the clamps ability to open and close.

4.4 Support

In case of any issues with the medical-grade plier, users can promptly seek assistance through our 24/7 help desk support by emailing support@ErgoCares.com for general inquiries. To report a security incident, users should immediately isolate the system and contact the security team via security@ErgoCares.com. When reporting problems, users are encouraged to provide detailed

information about the issue observed, and for security incidents, any suspected anomalies. This ensures a systematic approach to addressing concerns, with clear points of contact and instructions for different types of issues.

5 Product Documentation

The final prototype was 3D printed in 3 parts. Two halves of the handles/head and the fastener which connects the pieces. Our material of choice ended up being PLA; with our testing, we determined it was durable enough for our purpose and is also cost-efficient.

5.1 Mechanical Design

The design of the head was carefully designed to ensure a nice fit over the renal clamps. This ensured that nurses would not be hindered when working and allowed them to maximize their speed. The head of the clamp also includes grooves which helps it to grip the clamps better.

The handles were created to maximize the ergonomics of the pliers. They were designed to be comfortable while also reducing the strain that was put onto the thumb joint. By moving the force to the whole hand, the handles divert the force from being solely on the thumbs.

5.1.1 BOM (Bill of Materials)

Materials	**Cost (per unit)**	**Description**	**Link**
Spring mechanism	$17.99 (for 300 with 30 different compression spring)	Internal spring for efficient clamping action. Different spring sizes gives us more to test with.	Springs
Rubber grip	$10 - $27	Rubber band on the head to help with gripping onto clip	Grip 1 Grip 2 Grip 3 Grip 4
Screws and Fasteners	up to $0.67 per piece	For assembly	Home Depot

Plastic components	Free. The university lets us 3D – print materials	Various plastic parts for lightweight construction	

5.1.2 Equipment list

The only equipment required is a 3D Printers.

5.1.3 Instructions

Step 1: 3D print the separate parts (2 handles+heads, fastener)

Step 2: Connect the two halves of the handles at the center with the fasteners

Step 3: Obtain the spring and glue to each handle in the designed hole

5.2 Testing & Validation

Clip holding capability	The head design struggled to hold the clip, a modified head design is needed
Material durability (of our 3D printed clamp)	The PLA was not strong enough and broke, the printer settings will need to be carefully modified
Comfortability of device	Yes, the device is ergonomic and reduces the strain on the thumb

6 Conclusions and Recommendations for Future Work

Lessons learned through the creation of the Renal Clamp Plier is how to efficiently and effectively work in a team environment to brainstorm, design, and create a product for our client. Through the development of this product, our team learned valuable skills such as time management, cooperation, computer aided design and 3D printing.

With a few more months to develop and test our product, we would have created a head that is adjustable so that our pliers would be more universal to varying clip sizes. This was unfortunately abandoned so we could focus on clipping a standard size but would be a great way to expand our product's clientele.

7 Bibliography

GNG2101 A2.1 - Project Deliverables.docx

APPENDICES

8 APPENDIX I: Design Files

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Makerrepo	https://makerepo.com/mbelk059/1824.gng2101-21-ergocares-innovations	Nov 16, 2023
Project Deliverables	https://uottawamy.sharepoint.com/personal/smeas098_uottawa_ca/Documents/GNG2101%20A2.1%20-%20Project%20Deliverables.docx	Sept 17, 2023
Project Proposal	https://makerepo.com/project_proposals/384	Aug 25, 2023