

# Patient Operated Cooling Device for Knee

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## Abstract

The goal of this project is to create a device that maintains a cool temperature on the knee and can be operated by the patient without the help of a caretaker. Our design utilizes a Peltier cooler to maintain a constant temperature of a cold compress. Preliminary testing of our device was successful in maintaining a constant temperature of 10-15°C.

## Introduction

Anterior cruciate ligament (ACL) repair is a common sports injury procedure numbering about 100,000 surgeries performed each year in the United States. After ACL reconstruction with the patellar tendon, patients are instructed to ice their knee in order to reduce pain and inflammation. Patients are also instructed not to walk for 2-3 days post-surgery. ACL tears can significantly affect someone's life, especially if they are an athlete or have a job that requires standing for long periods of time.

### Existing Solutions

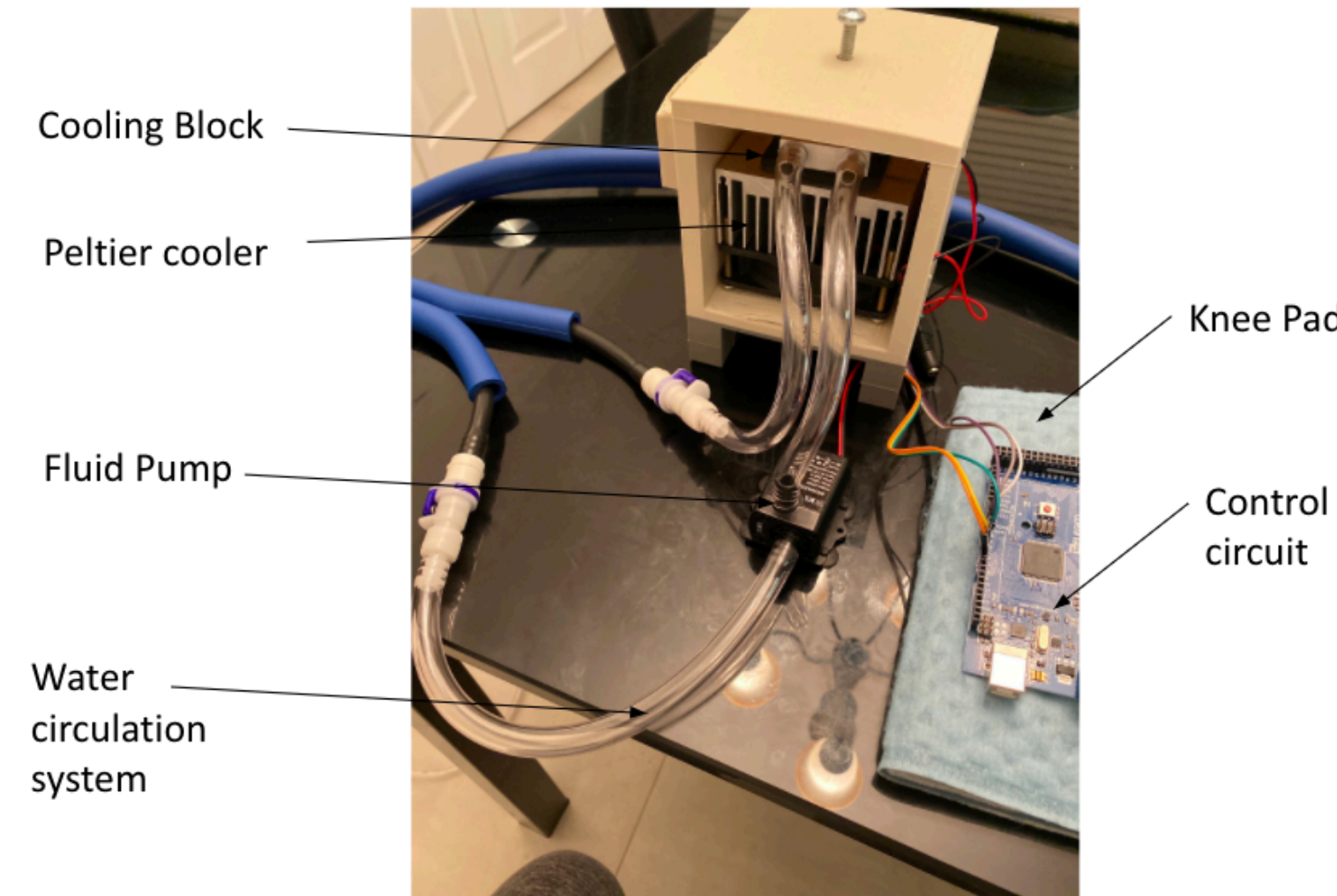
- Traditional Ice Pack: Although traditional ice packs are the cheapest option, they have a very inconsistent temperature profile and melt quickly requiring a caretaker to help the patient replace the ice
- Cryotherapy Devices: These devices are very costly and still require ice to be replaced every few hours for the device to function
- Gel Ice Pack: Gel ice packs are another less expensive option, but they require hours of freezing prep and still melt quickly

### Our Device:

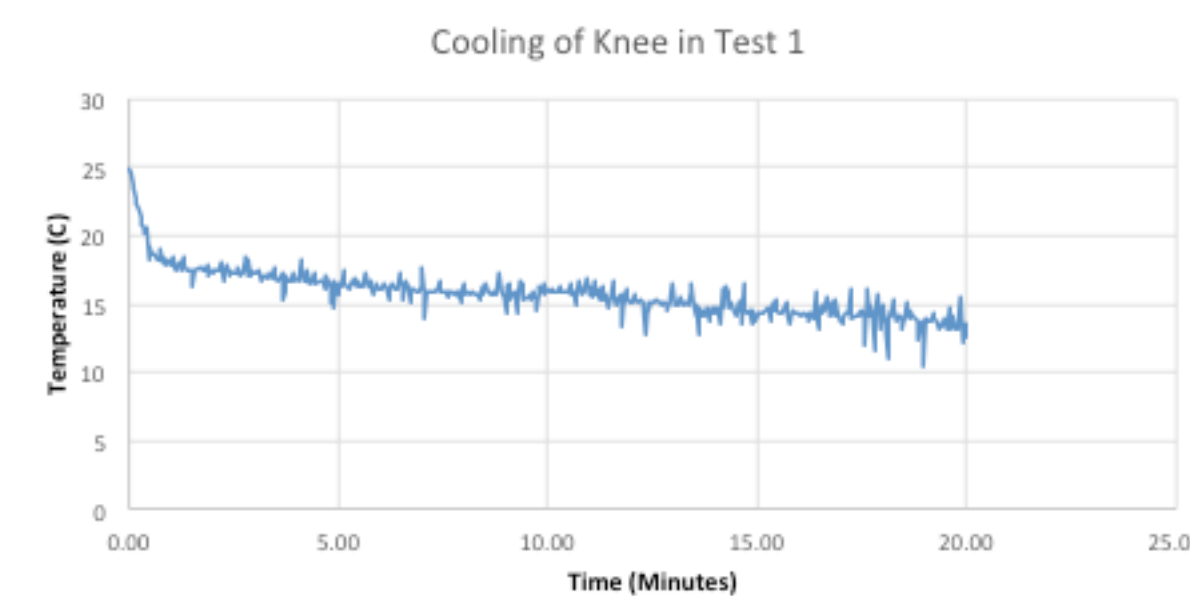
Must Have	Should Have	Could Have
<ul style="list-style-type: none"><li>• Require less manual labor than the traditional ice pack</li><li>• Be able to reduce knee temperature to 10-15°C for 20 minutes</li><li>• Electronic temperature sensing</li></ul>	<ul style="list-style-type: none"><li>• Ability to operate without actual ice</li><li>• Be able to be easily controlled by the patient</li></ul>	<ul style="list-style-type: none"><li>• Automated temperature cycling</li></ul>

## Methods | Design | Analysis

The core component of our design is a Peltier cooler that is connected to a cooling block which is connected to a pump that will circulate water through the device. The function of the control circuit is to track the temperature of the knee and to regulate the pumping. In order to test our device we placed the device on the knee and turned it on for 20 minutes while tracking the temperature, and then turned it off and tracked the temperature for an additional 40 minutes.



## Results



Our results show that our device was able to reduce the knee temperature to 15 °C after 12 minutes and then maintained a temperature of 10-15°C.

## Conclusion

The CryoFreeze device is a portable device that is used to cool the knee after ACL reconstruction surgery using the patellar tendon. This device cools via a Peltier cooler that can be turned on and off by the user. The Peltier cooler will cool circulating water through a knee pad. Cryofreeze can cool the knee to about 15°C. This device will greatly improve the recovery process for ACL patients as it allows them more independence and relieves pressure from their caretaker. Our next step will be to create a casing for all of the electronics and pump and to ensure that the pump is powerful enough to circulate the water. In terms of regulatory affairs we will file a 510(k) form and conduct benchtop testing for our Class II device. In the future we would like to add a handle to increase ease of use, and introduce battery compatibility.

## Acknowledgments

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## References

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