

**Title of Abstract Name: A Novel Design for a Continuous Passive Movement Machine for use in Hand Physiotherapy**

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Specific Aims and Objectives:

This project aimed to design a CPM machine for use in hand physiotherapy that improves on the current market leader.

Methods:

The design uses a forearm-based smart motor that produces externally powered flexion of the MCP, PIP, and DIP joints via nylon routed through pulleys mounted volar to the user's digits. The motor then runs in reverse, allowing the digits to return to an extended position using elastic mounted between the machine's backplate and the posterior of the user's distal phalanges. The principles of movement in this design are comparable to that of an FDP/FPL tendon, with an elastic component for extension. The machine is 3D-printed in PLA and uses a rechargeable 3.7v 18650 battery running a stepper motor. The code is programmed with C++ via the Arduino platform on an ESP32 microcontroller. The user controls the machine via Bluetooth using a phone application specific to the machine.

Results:

The novel design improves on many areas of current hand CPM machines, including; functionality, cost, size, ergonomics, safety, and ease of use.

Discussion/Conclusion:

CPM machines for hand physiotherapy already exist, though are used infrequently due to the limitations of current designs. Clear indications for CPM use exist when the patient is unable to produce adequate voluntary movement. Examples of these are; High spinal injuries, Post-stroke weakness, Guillain-Barré syndrome, and extended periods of intubation in ICU. In these situations, staff have to manually stretch patients' hands to prevent the rapid development of stiffness. Often this is not enough and patients are left with reduced hand function despite making neurological improvements. Other indications for CPM use such as use after surgery and trauma are currently unproven. The market-leading machine costs around \$20,000, is slow to set up, and is complicated to use. The Middlemore Hands service owns this machine, though it is only used twice yearly due to these limitations. Although unpolished, this novel design improves on many aspects that make current generation CPM use impractical for clinical application.