ExoFlex: Total Knee Replacement Rehabilitation Device

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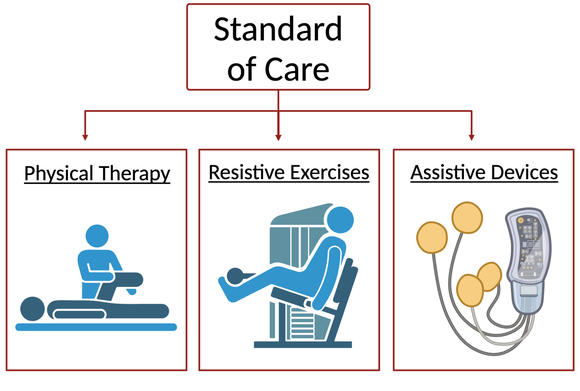
Objective

Develop an at-home rehabilitation solution for patients recovering from Total Knee Replacement (TKR) surgery.

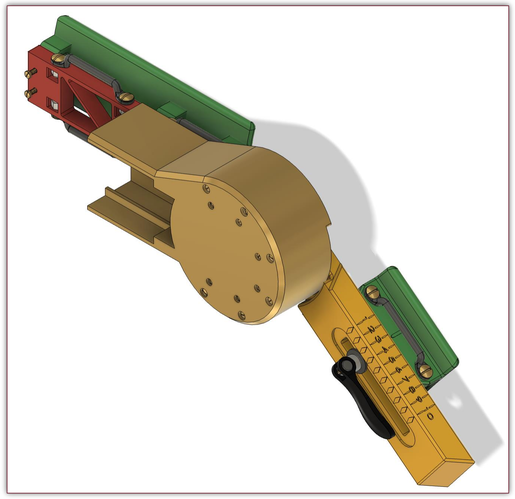
Background

- TKR is an effective treatment option for knee osteoarthritis (790,000 procedures performed per year).
- However, it is a very invasive surgery that requires extensive quadriceps strength recovery.
- At-home physical therapy options have been growing in popularity due to convenience and accessibility.
- Currently no device able to provide the standard of care in-home.



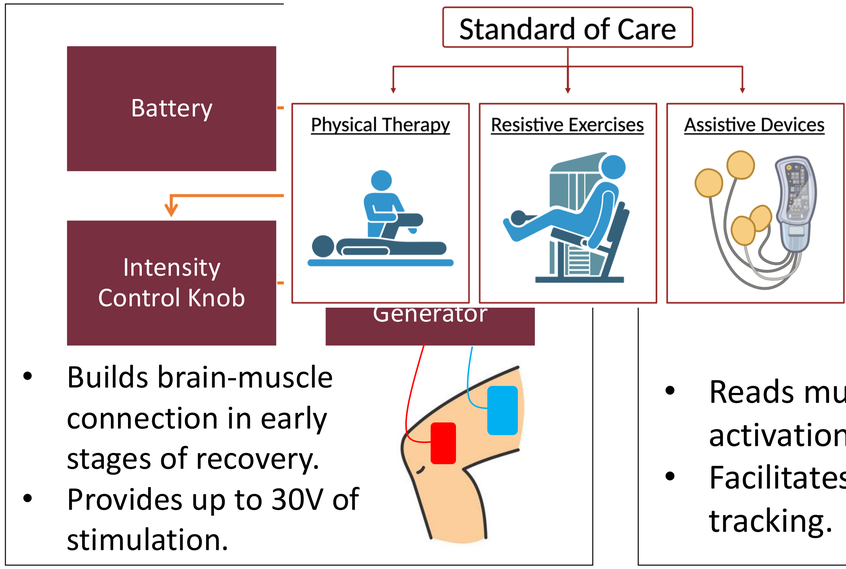
ExoFlex

- Provides variable resistance for progressive quadriceps strengthening.
- Incorporates neuromuscular electrical stimulation (NMES) and electromyography (EMG) to enhance therapy feedback.



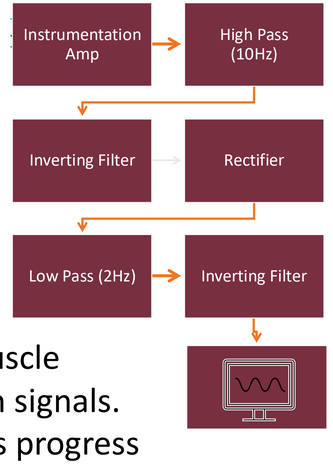
- Motor housing encloses the CubeMars AK80-8 actuator.
- Constructed from 3D-printed Nylon 12 and lined with leather for user comfort.
- Includes an adjustable shank and side-release buckles to accommodate different leg sizes.

Electrical Stimulation



- Builds brain-muscle connection in early stages of recovery.
- Provides up to 30V of stimulation.

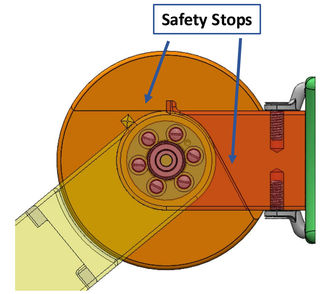
Electromyography (EMG)



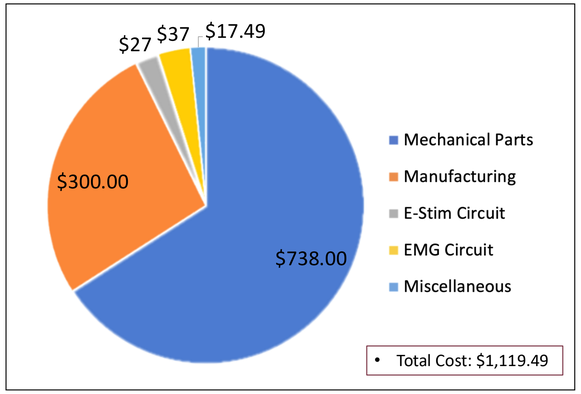
- Reads muscle activation signals.
- Facilitates progress tracking.

Biomechanical Accuracy

- Natural motion constraints allow flexion from 0° to 120° and restrict lateral knee motion ($0 \pm 2°$).



Cost Analysis



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